

Marking Scheme

- For every correct answer you earn four marks (+4).
- For every incorrect answer you lose one mark (-1).

Marks Obtained		Percentage Score
Maximum Marks	224	

SECTION-I : NCERT Liners

Choose whether the statement is True (T) or False (F).

- | | T | F |
|--|--------------------------|--------------------------|
| 1. Drugs like azidothymidine and Taxol are used as remedy for the treatment of AIDS. | ☐ | ☐ |
| 2. Cisplatin is an effective drug in cancer therapy. | ☐ | ☐ |
| 3. The constituents of a compound cannot be separated into simpler substances by physical methods. | ☐ | ☐ |
| 4. SI units of amount of substance and time are mole and second respectively. | ☐ | ☐ |
| 5. The temperature which is same at both Fahrenheit and Celsius scale is -40 . | ☐ | ☐ |
| 6. Boiling point of water on Fahrenheit scale is 212°F . | ☐ | ☐ |
| 7. Negative temperature on Kelvin scale is not possible. | ☐ | ☐ |
| 8. Scientific notation for 0.00016 is 1.6×10^{-3} . | ☐ | ☐ |
| 9. Zeros at the right of a number after decimal are not significant. | ☐ | ☐ |
| 10. Precision refers to the agreement of a particular value to the true value of the result. | ☐ | ☐ |
| 11. If 7.25 is to be rounded off to 2 digits, then it should be written as 7.3. | ☐ | ☐ |
| 12. A given compound always contains exactly the same proportion of elements by mass. | ☐ | ☐ |
| 13. SO_2 and SO_3 are the two gases showing law of multiple proportions but the same is not followed by CO and CO_2 . | ☐ | ☐ |
| 14. Law of gaseous volume was well explained by Dalton's atomic theory. | ☐ | ☐ |
| 15. $1 \text{ amu} = 1.66056 \times 10^{-24} \text{ g}$. | ☐ | ☐ |
| 16. If relative abundance of 3 isotopes of carbon ^{12}C , ^{13}C and ^{14}C are 98.892, 1.108 and 2×10^{-10} respectively, then the average atomic mass of carbon would be 12.01 u. | ☐ | ☐ |
| 17. Term formula unit mass is used for the compounds like CO_2 , CH_4 etc. | ☐ | ☐ |

18. Mass of 5.6 L of CO_2 gas at STP is 22 g.
19. Mass percentage of nitrogen in urea is 60%.
20. Percentage composition is useful to check the purity of a given sample of a compound.
21. A balanced chemical equation has the same number of atoms of each element on both sides of the equation. This statement is in accordance with law of conservation of mass.
22. Moles of methane required to produce 88 g of CO_2 in sufficient oxygen supply is 2.
23. Mass percentage of solution in which 2 g solute is added in 48 g of water is 2%.
24. The volume of water to be added to change the molarity of 200 mL 0.5 M aqueous solution to 0.1 M is 800 mL.
25. If the mole fraction of solute in a solution is 0.35, then mole fraction of water would be 0.75.
26. Stock solution is the solution which has molarity equal to molality.

SECTION-II : Assertion-Reason type

In the following questions, a statement of assertion (A) is followed by a statement of reason (R).

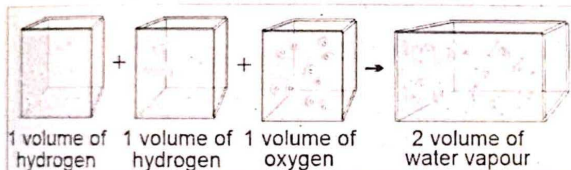
- (1) If both Assertion & Reason are true and the Reason is the correct explanation of the Assertion, then mark (1).
- (2) If both Assertion & Reason are true but the Reason is not the correct explanation of the Assertion, then mark (2).
- (3) If Assertion is true statement but Reason is false, then mark (3).
- (4) If both Assertion & Reason are false statements, then mark (4).

1. A : 232.508 can be written as 2.32508×10^2 in scientific notation.
R : In scientific notation, any number is represented in the form $N \times 10^n$ (where n is an exponent having positive or negative values and N can vary between 1 to 10).
2. A : Irrespective of the source, a given compound always contains same elements in the same proportion.
R : This law is referred to as law of multiple proportions.
3. A : All the isotopes of a given element show same chemical behaviour.
R : Chemical properties of atoms are controlled by the number of electrons, which are determined by the number of protons in the nucleus that is same in all the isotopes of an element.
4. A : One gram molecule of carbon dioxide is 44 g.
R : One mole is equal to one gram molecule.
5. A : Equal mole of H_2 and N_2 have same volume at same temperature and pressure.
R : 1 mole gas at STP occupies 22.4 L volume.
6. A : Significant figure are meaningful digits which are known with certainty.
R : Exact numbers have infinite significant figures.
7. A : SI unit of amount of substance is mole.
R : Mole is the amount of substance of a system which contains as many elementary entities as there are atoms in 0.012 kg of carbon-12.
8. A : Glucose is a pure substance.
R : Glucose contains carbon, hydrogen and oxygen in a fixed proportion.
9. A : 2 g of H_2 reacts with 16 g of O_2 to give 18 g of H_2O .
R : Matter can neither be created nor destroyed in a chemical reaction.

10. A : One atomic mass unit is defined as a mass exactly equal to one twelfth the mass of one carbon-12 atom,
 $1 \text{ amu} = \frac{1}{N_A} \text{ gram.}$
 R : Both 106 g of sodium carbonate and 12 g of graphite contain 1 g atom of carbon atoms.
11. A : 40 grams of NaOH dissolved in 200 mL of aqueous solution has molarity 5.
 R : Molarity is number of moles of solute present in one litre of solution
12. A : 100 g of CaCO_3 on heating forms 56 g of CaO .
 R : 22.4 L of CO_2 is evolved at STP in the above conversion.
13. A : Molar volume of gases change considerably with temperature and pressure.
 R : Molar volume of a ideal gas at STP is 22.4 L.
14. A : Molar mass is the mass of one mole of a substance in gram.
 R : Molar mass of $\text{NH}_3 = 17 \text{ g mol}^{-1}$.
15. A : Mole fraction is a unitless quantity.
 R : Mole fraction is the ratio of number of moles of a particular component to the total number of moles of the solution.
16. A : Atomicity of nitrogen molecule is 2.
 R : One mole of nitrogen molecule contains two mole of nitrogen atoms.
17. A : The standard unit for expressing the mass of an atom is a.m.u.
 R : One a.m.u. = $\frac{1}{6.02 \times 10^{23}} \text{ g.}$

SECTION-III : Check Your Understanding

PROBLEM 1:



Now, answer the following questions

- 2 volume of H_2 and 1 volume of O_2 combines to produce 2 volume of water vapour. This statement is in accordance with
 (1) Law of constant proportions by mass
 (2) Law of multiple proportions
 (3) Gay Lussac's law of gaseous volume
 (4) Dalton's atomic theory
- In Haber Process, 30 L of dihydrogen and 10 L of dinitrogen were taken for reaction but the yield was only 50% of the expected product. The volumes of the various gases in the mixture post reaction are
 (1) 15 L dihydrogen, 5 L dinitrogen and 20 L ammonia
 (2) 10 L dihydrogen, 5 L dinitrogen and 10 L ammonia
 (3) 10 L dihydrogen, 5 L dinitrogen and 20 L ammonia
 (4) 15 L dihydrogen, 5 L dinitrogen and 10 L ammonia

- Volume of oxygen gas needed for the production of 400 mL of CO_2 by the oxidation of 400 mL of carbon monoxide is
 (1) 200 mL (2) 100 mL
 (3) 400 mL (4) 600 mL

PROBLEM 2:

Percentage composition of the compound is the relative mass of each of the constituent in 100 parts of it. Percentage composition is an important tool to find empirical formula and molecular formula of the compound.

Empirical formula of the compound represents whole number ratio of various atoms present in its one molecule whereas molecular formula shows the exact number of different atoms present in its one molecule.

Now, answer the following questions

- The percentage by mass of nitrogen in nitric acid is
 (1) 14.63%
 (2) 20.22%
 (3) 22.22%
 (4) 28.29%

5. Choose the incorrect statement from the following
- (1) If the mass percentage of various elements present in a compound is known, its molecular formula can be obtained using their simple ratio
 - (2) Empirical formula mass and molecular mass of a compound may or may not be same
 - (3) Percentage by mass of carbon is more than that of oxygen in ethanol
 - (4) The ratio of molecular mass to empirical formula mass is always a simple whole number
6. An organic compound has three elements carbon, hydrogen and oxygen in it and the mass percentage of carbon and oxygen in it is 40% and 53.34% respectively. The empirical formula and possible organic compound is
- (1) CH_2O and Ethanol
 - (2) CH_2O and Glucose
 - (3) $\text{C}_2\text{H}_4\text{O}_2$ and Ethanoic acid
 - (4) $\text{C}_2\text{H}_4\text{O}$ and Ethanal
7. Percentage of oxygen by mass in sulphuric acid is approximately
- (1) 76.38%
 - (2) 72.22%
 - (3) 60.44%
 - (4) 65.31%

PROBLEM 3:

A balanced chemical equation provides a lot of information about the reactants and the products participating in a chemical reaction.

Not only the physical state of the reactants and the products we can identify from it but also their number of moles participating in the reaction, can be identified.

By looking at the stoichiometric coefficients, we can find the moles of reactants and the products participating in the reaction. Many a time, the amount of reactants and the amount of products taken for the reaction are different from the amount required by a

balanced chemical reaction. In such cases, reactant that gets consumed during the course of reaction, limits the amount of product formed and termed as limiting reagent while the other reactant which is left is called excess reagent. The amount of product formed is dependant on the amount of limiting reagent available for reaction.

Now, answer the following questions.

8. 1.6 g of methane is burnt in 9.6 g of oxygen and excess reagent is allowed to further take part in other reaction. Choose the correct option showing correct amount of excess reagent and its possible reaction.
- (1) 0.2 mol of O_2 , $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$
 - (2) 3.2 g of O_2 , $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$
 - (3) 0.05 mol of CH_4 , $\text{CH}_4 + \text{Cl}_2 \rightarrow \text{CH}_3\text{Cl} + \text{HCl}$
 - (4) 0.2 g of CH_4 , $\text{CH}_4 + \text{Cl}_2 \rightarrow \text{CH}_3\text{Cl} + \text{HCl}$
9. Amount of water produced when 2 mol of CO_2 is passed through lime water is
- (1) 36 g of water
 - (2) 54 g of water
 - (3) 72 g of water
 - (4) 90 g of water
10. Phosphine (PH_3) is a poisonous gas which decompose to form molecular phosphorus (P_4) and hydrogen gas. If 200 mL of PH_3 decomposed then observed change in volume is
- (1) 100 mL increase in volume
 - (2) 100 mL decrease in volume
 - (3) 200 mL increase in volume
 - (4) 200 mL decrease in volume

PROBLEM 4:

Molarity and molality both are the concentration terms to represent the concentrations of the solution. Molarity of solution represents the number of moles of solute present in 1 L of solution while molality of solution is equal to the number of moles of solute which are dissolved in 1 kg of the suitable solvent. The units of these terms are moles/litre and moles/kg respectively. Knowing density of the solution, can help in the conversion of molarity into molality.

Now, answer the following questions.

11. Consider the following statements and choose the correct option.

Statement I: Both molality and molarity represent concentration of solution but the value of molarity remain constant over all the range of temperatures.

Statement II: Volume is a temperature dependant property.

- (1) Both the statements are correct
- (2) Both the statements are incorrect
- (3) Statement I is correct while statement II is incorrect
- (4) Statement II is correct while statement I is incorrect

12. Molality of a 2 M aqueous solution of glucose is (density of solution = 1.2 g mL^{-1})

- (1) 3.125 M
- (2) 2.38 m
- (3) 1.612 M
- (4) 0.612 m

13. Mass of CH_3COOH in its 212 g of 1 molal aqueous solution is

- (1) 6 g
- (2) 3 g
- (3) 12 g
- (4) 24 g

ANSWERS

Class XI

Chapter-1 : Some Basic Concepts of Chemistry

SECTION-I : NCERT Liners

- | | | |
|----------------------------|-----------------------------|-----------------------------|
| 1. (F), [NCERT-XI, Pg. 4] | 10. (F), [NCERT-XI, Pg. 13] | 19. (F), [NCERT-XI, Pg. 18] |
| 2. (T), [NCERT-XI, Pg. 4] | 11. (F), [NCERT-XI, Pg. 13] | 20. (T), [NCERT-XI, Pg. 19] |
| 3. (T), [NCERT-XI, Pg. 6] | 12. (T), [NCERT-XI, Pg. 15] | 21. (T), [NCERT-XI, Pg. 21] |
| 4. (T), [NCERT-XI, Pg. 7] | 13. (F), [NCERT-XI, Pg. 15] | 22. (T), [NCERT-XI, Pg. 22] |
| 5. (T), [NCERT-XI, Pg. 10] | 14. (F), [NCERT-XI, Pg. 16] | 23. (F), [NCERT-XI, Pg. 23] |
| 6. (T), [NCERT-XI, Pg. 10] | 15. (T), [NCERT-XI, Pg. 17] | 24. (T), [NCERT-XI, Pg. 23] |
| 7. (T), [NCERT-XI, Pg. 10] | 16. (T), [NCERT-XI, Pg. 17] | 25. (F), [NCERT-XI, Pg. 23] |
| 8. (F), [NCERT-XI, Pg. 11] | 17. (F), [NCERT-XI, Pg. 17] | 26. (F), [NCERT-XI, Pg. 24] |
| 9. (F), [NCERT-XI, Pg. 12] | 18. (F), [NCERT-XI, Pg. 18] | |

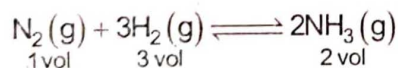
SECTION-II : Assertion-Reason type

- | | | |
|--------|---------|---------|
| 1. (1) | 7. (2) | 13. (2) |
| 2. (3) | 8. (1) | 14. (2) |
| 3. (1) | 9. (1) | 15. (1) |
| 4. (1) | 10. (2) | 16. (2) |
| 5. (2) | 11. (1) | 17. (2) |
| 6. (2) | 12. (2) | |

SECTION-III : Check Your Understanding

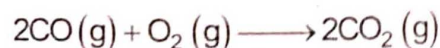
1. Answer (3)
According to Gay-Lussac law of gaseous volumes, when gases combine or are produced in a chemical reaction they do so in a simple ratio by volume, provided all gases are at the same temperature and pressure.

2. Answer (4)



	N ₂	H ₂	NH ₃
As per Law (Ideally)	10 L	30 L	20 L
Consumed/Produced (50% yield)	5 L	15 L	10 L
Final Composition	5 L	15 L	10 L

3. Answer (1)



200 mL	100 mL	200 mL
400	200 mL	400 mL

4. Answer (3)

$$\text{Mass \% of N} = \frac{\text{Mass of N in one molecule} \times 100}{\text{Molar mass of the compound}}$$

$$= \frac{14}{63} \times 100 = 22.22\%$$

5. Answer (1)

To get molecular formula using mass percentage of various elements, molecular mass of the compound also needs to be known

6. Answer (2)

Element	%	Atomic wt	Relative no. of atoms	Ratio
C	40	12	$\frac{40}{12} = 3.33$	$\frac{3.33}{3.33} = 1$
O	53.34	16	$\frac{53.34}{16} = 3.33$	$\frac{3.33}{3.33} = 1$
H	6.66	1	$\frac{6.66}{1} = 6.66$	$\frac{6.66}{3.33} = 2$

Empirical formula = CH_2O

This empirical formula is followed by glucose only ($\text{C}_6\text{H}_{12}\text{O}_6$) not by ethanol ($\text{C}_2\text{H}_5\text{OH}$ where empirical formula is $\text{C}_2\text{H}_6\text{O}$)

7. Answer (4)

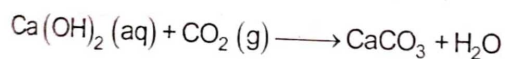
$$\% \text{ of O (by mass)} = \frac{64}{98} \times 100 = 65.31\%$$

8. Answer (2)

	CH_4	+	2O_2	$\rightarrow$	CO_2	+	$2\text{H}_2\text{O}$
Stoichiometric ratio	1 mol		2 mol				
Given amount	0.1 mol		0.3 mol				
	↓		↓				
	Limiting Reagent		Excess Reagent				

For 0.1 mol CH_4 , 0.2 mol of O_2 is needed so excess moles of $\text{O}_2 = 0.3 - 0.2 = 0.1$ mol
 $= 3.2$ g O_2

9. Answer (1)



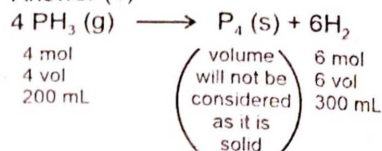
Lime water

1 mol CO_2 produce mol H_2O

$\therefore$ 2 mol CO_2 produce 2 mol H_2O

Mass of water produced = $2 \times 18 = 36$ g

10. Answer (1)



$$\begin{aligned} \text{Change in volume} &= 300 - 200 \\ &= 100 \text{ mL (Increased)} \end{aligned}$$

11. Answer (4)

Molarity is temperature dependant.

12. Answer (2)

$$M = 2 \text{ mol L}^{-1}$$

Let volume of solution be 1 L

$$\begin{aligned} \text{Moles of glucose in solution} &= M \times V \\ &= 2 \text{ mol} \end{aligned}$$

$$\begin{aligned} \text{Mass of glucose} &= 2 \times 180 = 360 \text{ g} \\ &(\text{C}_6\text{H}_{12}\text{O}_6) \end{aligned}$$

$$\text{density of solution} = \frac{\text{mass of solution}}{\text{volume of solution}}$$

$$\therefore \text{Mass of solution} = 1.2 \text{ g mL}^{-1} \times 1000 \text{ mL} = 1200 \text{ g}$$

$$\begin{aligned} \therefore \text{Mass of solvent} &= 1200 - 360 = 840 \text{ g} \\ &= 0.84 \text{ kg} \end{aligned}$$

$$\text{molality} = \frac{\text{moles of solute}}{\text{mass of solvent (kg)}}$$

$$= \frac{2 \text{ mol}}{0.84 \text{ kg}} = 2.38 \text{ m}$$

13. Answer (3)

$$m = \frac{\text{mol of solute}}{\text{mass of solvent (kg)}}$$

1 mole CH_3COOH i.e. 60 g is present in 1000 g of water.

So, 1060 g of the solution contains 60 g of CH_3COOH

Therefore, 212 g of the solution will contain 12 g of CH_3COOH

2

Chapter

1. For every correct answer you earn four marks (+4).
2. For every incorrect answer you lose one mark (−1).

Marks Obtained	=	208	Percentage Score
Maximum Marks			

Choose whether the statement is True (T) or False (F).

1. The cathode rays start from anode and move towards the cathode.
2. For canal rays the charge to mass ratio depends on the gas from which these originate.
3. Thomson's atomic model explains the electrical neutrality of an atom.
4. The radio frequency used for broadcasting is around 10^{10} Hz.
5. Energy is emitted or absorbed by atoms and molecules in continuous manner.
6. The black body emits and absorbs radiations of all frequencies uniformly.
7. The kinetic energy of a photo electron is directly proportional to the intensity of radiation.
8. The Balmer series of lines for hydrogen atom appear in the visible region.
9. The study of emission or absorption spectra is referred as spectroscopy.
10. Line emission spectra is used in chemical analysis to identify unknown atoms.
11. The angular momentum of an electron is not quantised.
12. In hydrogen atom the de Broglie wavelength of an electron in the second Bohr orbit is 222 pm.
13. An orbital is designated by three quantum numbers while an electron in an atom is designated by four quantum numbers.
14. According to the Heisenberg's uncertainty principle $\Delta v \cdot \Delta x \leq \frac{h}{4\pi m}$
15. The energy of 2s orbital is less than the energy of 2p orbital for Hydrogen atom.
16. Be^{2+} and Na^+ are isoelectronic.
17. Larger the value of n the larger is the radius of orbit for H like species.

[illegible]

18. Maximum number of electrons in a subshell of an atom is $4l + 2$ where l represents azimuthal quantum number. ☐
19. Magnetic quantum number gives information about the spatial orientation of an atomic orbital. ☐
20. Two electrons occupying the same orbital are distinguished by magnetic quantum number. ☐
21. The four quantum numbers of valence electron of potassium are 4, 0, 1, $\frac{1}{2}$. ☐
22. The outer electronic configuration of the ground state of chromium atom is $3d^4 4s^2$. ☐
23. The energy of the electron in the $3p$ orbital is less than that in the $4s$ orbital in the hydrogen atom. ☐
24. Smaller the size of the orbit lower is the energy of the orbit. ☐
25. According to Rutherford's atomic model atoms have mostly empty space. ☐
26. The energy of the orbitals in the same subshell decrease with increase in the atomic number. ☐
27. The maximum number of electrons in the subshell with principal quantum number n is equal to n^2 . ☐

SECTION-II : Assertion-Reason type

In the following questions, a statement of assertion (A) is followed by a statement of reason (R).

- (1) If both Assertion & Reason are true and the Reason is the correct explanation of the Assertion, then mark (1).
- (2) If both Assertion & Reason are true but the Reason is not the correct explanation of the Assertion, then mark (2).
- (3) If Assertion is true statement but Reason is false, then mark (3).
- (4) If both Assertion & Reason are false statements, then mark (4).

1. A : Rutherford model cannot explain the stability of an atom.
R : According to electromagnetic theory of Maxwell, a moving electron in an orbit will emit radiation and the orbit will thus continue to shrink.
2. A : For $l = 0$, the only permitted value of m_l is 0.
R : Values of m_l varies from $-l$ to $+l$.
3. A : The third electron of lithium is not allowed to be filled in $1s$ orbital.
R : Pauli's exclusion principle states that "only two electrons may exist in the same orbital and these electrons must have opposite spin".
4. A : The ratio of orbit angular momentum and orbital angular momentum of $4d$ electron is $4 : \sqrt{6}$.
R : Orbital angular momentum is $\sqrt{l(l+1)} \frac{h}{2\pi}$
while orbit angular momentum is $\frac{nh}{2\pi}$.
5. A : The orbital wave function ψ is a mathematical function of the coordinates of the electron.
R : ψ^2 at a point gives the probability density of the electron at that point.
6. A : yz -plane and xy -plane are the nodal planes for d_{xz} orbital.
R : There are no nodal planes for d_{z^2} orbital.

7. A : Circumference ($2\pi r$) of the shell is integral multiple of de Broglie wavelength of electron in shell.

R : de Broglie wavelength of any particle of mass (m) and moving with a velocity (v) is $\frac{h}{mv}$.

8. A : While filling electrons in a subshell, they are first singly occupied with parallel spin.

R : This arrangement of electrons lead to minimum repulsion and maximum stability.

9. A : The series of spectral lines observed in the visible region of the atomic spectrum of hydrogen is known as Balmer series.

R : The visible lines of the hydrogen spectrum obey the formula.

$$\bar{\nu} = R \left(\frac{1}{2^2} - \frac{1}{n^2} \right)$$

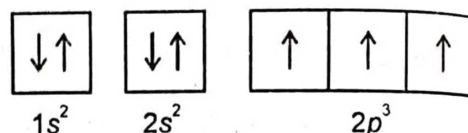
10. A : The s orbital electron spends more time close to the nucleus in comparison to p orbital electron.

R : s -orbital has spherical shape.

11. A : Electronic configuration of Ca ($Z = 20$) is $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$.

R : Energy of $4s < 3d$. Hence, $4s$ is filled before $3d$ as decided by Aufbau rule.

12. A : The electronic configuration of nitrogen atom is represented as



and not as



R : The electronic configuration of the ground state of an atom is the one which has the greatest multiplicity.

13. A : Classical mechanics fails when applied to microscopic objects like electrons, atoms, molecules etc.

R : Classical mechanics ignores the concept of dual behaviour of matter.

SECTION-III : Check Your Understanding

PROBLEM 1:

The particle nature of light posed a dilemma for scientists. On the one hand, it could explain the black body radiation and photoelectric effect satisfactorily but on the other hand, it was not consistent with the known wave behaviour of light which could account for the phenomena of interference and diffraction. The only way to resolve the dilemma was to accept the idea that light possesses both particle and wave-like properties, i.e., light has dual behaviour. Depending on the experiment, we find that light behaves either as a wave or as a stream of particles. Whenever radiation interacts with matter, it displays particle like properties in contrast to the wavelike properties (interference and diffraction), which it exhibits when it propagates. This concept was totally alien to the way the scientists thought about matter and radiation and it took them a long time to become convinced of its validity. Some microscopic particles like electrons also exhibit this wave-particle duality.

- The radiation emitted by hot bodies is
 - X-rays
 - Micro wave
 - γ -rays
 - Black body radiation
- The number of photons emitted from a monochromatic light of wavelength $5000 \text{ \AA}$ to give 1 J energy are

(1) 2.5×10^{16}	(2) 3.5×10^{18}
(3) 2.5×10^{18}	(4) 2.5×10^{19}
- The threshold energy is given as ϵ_0 and radiation of energy ϵ falls on metal then velocity is

- | | |
|---|---|
| (1) $\left(\frac{2(\epsilon - \epsilon_0)}{M} \right)^{1/2}$ | (2) $\left(\frac{2\epsilon_0 - \epsilon}{M} \right)^{1/2}$ |
| (3) $\left(\frac{2(\epsilon - \epsilon_0)}{M} \right)^{3/2}$ | (4) $\left(\frac{2(\epsilon_0 - \epsilon)}{M} \right)^{3/2}$ |

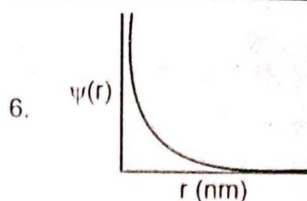
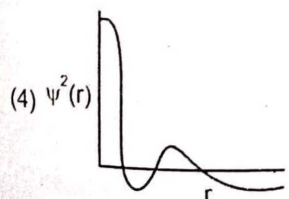
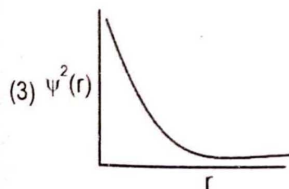
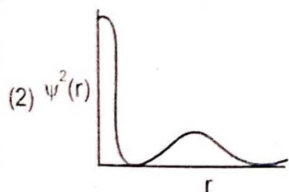
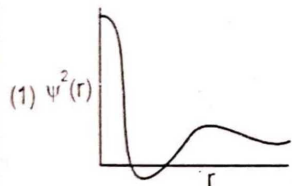
PROBLEM 2:

The orbital wave function or ψ for an electron in an atom has no physical meaning. It is simply a mathematical function of the coordinates of the electron. According to the German physicist, Max Born, the square of the wave function, (i.e., ψ^2) at a point gives the probability density of the electron at that point. The region where this probability density function reduces to zero is called nodal surfaces or simply nodes. There are basically two types of nodes: Radial nodes and angular nodes.

4. The number of radial nodes in 4s and 4p orbitals are respectively

- (1) 2, 0
(2) 2, 2
(3) 3, 1
(4) 3, 2

5. The correct probability density distribution curve with respect to distance r for 2s orbital is



How many nodes are present in the given diagram?

- (1) 2
(2) 1
(3) 0
(4) 3

PROBLEM 3:

The energy of an electron in a hydrogen atom is determined solely by the principal quantum number. The orbitals having the same energy are called degenerate. The energy of an electron in a multi-electron atom does not depend only on its principal quantum number. In multi-electron atoms, besides the presence of attraction between the electron and nucleus, there are repulsion terms between every electron and other electrons present in the atom. Thus, the stability of an electron in multi-electron atom is because total attractive interactions are more than the repulsive interactions.

7. How many degenerate orbitals for $n = 3$ are in Be^{3+} ion

- (1) 5
(2) 8
(3) 9
(4) 16

8. For single - electron species the correct order of energy of given orbitals is

- (1) $5p > 5s > 4f > 4d$
(2) $3s = 3p = 3d > 2s = 2p > 1s$
(3) $3d > 3p > 3s = 2p > 2s > 1s$
(4) $3d > 3p > 3s > 2p > 2s > 1s$

9. The energies of orbitals in a multi-electron system depend on

- (1) n (principal quantum number) only
(2) $(n + l)$ both (principal and azimuthal quantum number)
(3) l (azimuthal quantum number) only
(4) m (magnetic quantum number) only

PROBLEM 4:

The presence of positive charge on the nucleus is due to the protons in the nucleus. In order to keep the electrical neutrality, the number of electrons in an atom is equal to the number of protons (atomic number, Z). The composition of any atom can be represented by using the normal element symbol (X) with superscript on the left hand side as the atomic mass number (A) and subscript (Z) on the left hand side as the atomic number (i.e., A_ZX). Isobars are the atoms with same mass number but different atomic number, for example ${}^{14}\text{C}$ and ${}^{14}\text{N}$. On the other hand, atoms with identical atomic number but different atomic mass number are known as Isotopes.

10. Number of neutron, proton and electron in Al^{3+} will be (mass number of Al is 27)
- (1) 14, 13 and 10 (2) 13, 14 and 13
(3) 10, 13 and 14 (4) 13, 13 and 10
11. The atoms which have different chemical properties but identical weights are called
- (1) Isothermals (2) Isotopes
(3) Isobars (4) Isotones
12. On which of the following do the chemical properties of atom mainly depend?
- (1) Protons
(2) Neutrons
(3) Protons and neutrons both
(4) Electrons

Chapter-2 : Structure of Atom

SECTION-I : NCERT Liners

- | | | |
|-----------------------------|-----------------------------|-----------------------------|
| 1. (F), [NCERT- XI, Pg. 30] | 4. (F), [NCERT- XI, Pg. 38] | 7. (F), [NCERT- XI, Pg. 42] |
| 2. (T), [NCERT- XI, Pg. 32] | 5. (F), [NCERT- XI, Pg. 44] | 8. (T), [NCERT- XI, Pg. 46] |
| 3. (T), [NCERT- XI, Pg. 33] | 6. (T), [NCERT- XI, Pg. 40] | 9. (T), [NCERT- XI, Pg. 44] |

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- | | | |
|------------------------------|------------------------------|------------------------------|
| 10. (T), [NCERT- XI, Pg. 44] | 16. (F), [NCERT- XI, Pg. 70] | 22. (F), [NCERT- XI, Pg. 65] |
| 11. (F), [NCERT- XI, Pg. 46] | 17. (T), [NCERT- XI, Pg. 48] | 23. (T), [NCERT- XI, Pg. 60] |
| 12. (F), [NCERT- XI, Pg. 50] | 18. (T), [NCERT- XI, Pg. 56] | 24. (T), [NCERT- XI, Pg. 47] |
| 13. (T), [NCERT- XI, Pg. 59] | 19. (T), [NCERT- XI, Pg. 56] | 25. (T), [NCERT- XI, Pg. 34] |
| 14. (F), [NCERT- XI, Pg. 51] | 20. (F), [NCERT- XI, Pg. 57] | 26. (T), [NCERT- XI, Pg. 61] |
| 15. (F), [NCERT- XI, Pg. 60] | 21. (F), [NCERT- XI, Pg. 63] | 27. (F), [NCERT- XI, Pg. 56] |

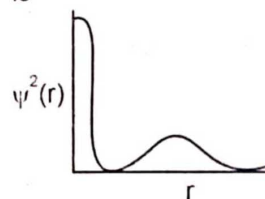
SECTION-II : Assertion-Reason type

- | | | |
|--------|--------|---------|
| 1. (1) | 5. (2) | 9. (2) |
| 2. (1) | 6. (2) | 10. (2) |
| 3. (1) | 7. (2) | 11. (1) |
| 4. (1) | 8. (1) | 12. (1) |
| | | 13. (1) |

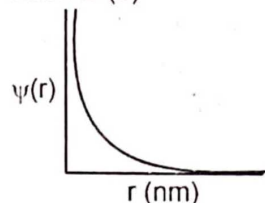
SECTION-III : Check Your Understanding

- Answer (4)
Black body radiation is also called hot body radiation.
- Answer (3)
Total energy = $n\varepsilon$
 $n \rightarrow$ no of photon $\varepsilon \rightarrow$ energy
 $\therefore n \times \frac{hc}{\lambda} = 1 \left[\varepsilon = h\nu = h\frac{c}{T} \right]$
$$n = \frac{1 \times \lambda}{h \times c} = \frac{1 \times 5000 \times 10^{-10}}{6.63 \times 10^{-34} \times 3 \times 10^8} = 2.5 \times 10^{18}$$
- Answer (1)
Einstein equation of photoelectric effect
 $E = E_0 + KE$ $E \rightarrow$ Energy
 $E_0 \rightarrow$ Threshold energy
 $KE = E_0 - E$ $KE_0 \rightarrow$ Kinetic energy
 $\therefore \frac{1}{2}mv^2 = E_0 - E$ $\left[KE = \frac{1}{2}mv^2 \right]$
$$V = \left[\frac{2(E_0 - E)}{m} \right]^{1/2}$$
- Answer (4)
We can calculate the radial nodes by using formula of a radial node radial nodes = $n - l - 1$
 $\therefore 4s$ radial node = $4 - 0 - 1 = 3$
 $4p$ radial node = $4 - 1 - 1 = 2$
- Answer (2)

The probability density distribution curve for 2s is



6. Answer (3)



this graph represent the orbital wave function as a function of distance r of the electron from the nucleus for 1s and 1s give zero nodes.

- Answer (3)
 Be^{3+} is hydrogen like atom so if follow the single electron system. Energy depend only on the principal quantum number
So for $n = 3$ $3s = 3p = 3d$ all having same energy so all are degenerate.
- Answer (2)
For single electron species energy depend only principal quantum number
So $3s = 3p = 3d > 2s = 2p > 1s$
- Answer (2)
The energy of orbitals in a multi electron system depend on $n + l$ both

n - principal quantum number

l - Azimuthal quantum number

10. Answer (1)

Number of proton = atomic number = 13

So proton = 13, neutrons = mass number -
number of protons = $27 - 13 = 14$

Al^{+3} contain 10 electron

11. Answer (3)

Isobars have different*chemical properties but
same mass number

12. Answer (4)

The chemical properties of atom mainly depend
on electrons

Classification of Elements and Periodicity in Properties

3

Chapter

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Marking Scheme

- For every correct answer you earn four marks (+4).
- For every incorrect answer you lose one mark (-1).

Marks Obtained		Percentage Score	
Maximum Marks	200		

SECTION-I : NCERT Liners

Choose whether the statement is True (T) or False (F).

- | | T | F |
|--|--------------------------|--------------------------|
| 1. According to Law of Triads, the middle element of each of the Triads had an atomic weight about half way between the atomic weights of the other two. | ☐ | ☐ |
| 2. Newland's Law of Octaves seemed to be true only for elements up to calcium. | ☐ | ☐ |
| 3. Lothar Meyer plotted the physical properties such as atomic volume, melting point and boiling point against atomic number. | ☐ | ☐ |
| 4. According to Mendeleev's Periodic Law, "The properties of the elements are a periodic function of their atomic weights". | ☐ | ☐ |
| 5. Mendeleev left the gaps under aluminium and silicon, for the undiscovered elements Eka-Aluminium and Eka-silicon. | ☐ | ☐ |
| 6. The IUPAC name and symbol for the element with atomic number 120 are unbinilium and Ubn. | ☐ | ☐ |
| 7. Lanthanoid series starts with Cerium (Z = 58) and ends at Lutetium (Z = 71). | ☐ | ☐ |
| 8. Seventh period of modern periodic table includes most of the man-made radioactive elements. | ☐ | ☐ |
| 9. All the group 1 elements (alkali metals) have ns^{1-2} valence shell electronic configuration. | ☐ | ☐ |
| 10. The elements in a particular group have the same number and the same distribution of electrons in their outermost shell. | ☐ | ☐ |
| 11. The s-block and p-block elements together are called representative elements. | ☐ | ☐ |
| 12. Group 16 and group 17 elements are known as halogens and chalcogens respectively. | ☐ | ☐ |
| 13. The noble gases exhibit very high chemical reactivity. | ☐ | ☐ |
| 14. The non-metallic character increases as we move from left to right across a period and metallic character increases as we go down the group. | ☐ | ☐ |
| 15. The general outer electronic configuration of d-block elements is $(n-1)d^{1-10} ns^{0-2}$. | ☐ | ☐ |

16. Actinoids, Th($Z = 90$) to Lr($Z = 103$) are characterised by outer electronic configuration $(n-2)f^{1-14}(n-1)d^{1-2}ns^2$.
17. The elements after uranium are called Transuranium elements.
18. The element with $Z = 117$ belongs to group 17 and electronic configuration is $[Rn]5f^{14}6d^{10}7s^27p^5$.
19. Caesium and gallium have very low melting points.
20. The order of increasing metallic character is $P < Si < Be < Mg < Na$.
21. Silicon, germanium, arsenic, antimony and tellurium are semi-metals or metalloids.
22. Electronegativity generally decreases across a period from left to right and increases down a group in a periodic table.
23. Electronegativity is inversely related to the metallic properties of elements.
24. The oxidation state of Al is +3 in $[Al(H_2O)_5Cl]^{2+}$ complex ion.
25. The normal oxide formed by the element on extreme left in the modern periodic table is most acidic in nature.
26. Al_2O_3 , As_2O_3 are amphoteric oxide.
27. CO, NO and N_2O are neutral oxides.

SECTION-II : Assertion-Reason type

In the following questions, a statement of assertion (A) is followed by a statement of reason (R).

- (1) If both Assertion & Reason are true and the Reason is the correct explanation of the Assertion, then mark (1).
- (2) If both Assertion & Reason are true but the Reason is not the correct explanation of the Assertion, then mark (2).
- (3) If Assertion is true statement but Reason is false, then mark (3).
- (4) If both Assertion & Reason are false statements, then mark (4).

1. A : The physical and chemical properties of the elements are periodic functions of their atomic numbers.
R : Periodicity based on atomic number was illustrated by Mendeleev's periodic law.
2. A : Filling of $4p$ orbitals start with Ga ($Z = 31$) with electronic configuration $4s^23d^{10}4p^1$.
R : $3d$ orbitals get completely filled at copper with electronic configuration $3d^{10}4s^2$.
3. A : Noble gases exhibit very low chemical reactivity.
4. A : Lanthanoids and actinoids are called f -block elements.
R : The last electron added to each element of lanthanoids and actinoids is filled in f -orbital.
5. A : $2p$ electron of boron is more shielded from the nucleus by the inner core of electrons than the $2s$ electrons of beryllium.
R : It is easier to remove the $2p$ electron from boron compared to the removal of $2s$ -electron from beryllium.

6. A : Across a period, increasing nuclear charge outweighs the shielding.
R : As we move from left to right along a period of periodic table, the outermost electrons are held more and more tightly to the nucleus.
7. A : The elements become more metallic as we go down in a group.
R : The non-metallic character increases as we go from left to right across the periodic table.
8. A : Each d -block series contains 10 elements.
R : The d -orbitals can have five possible orientations in space and can accommodate maximum of 10 electrons in the d -subshell.
9. A : The maximum covalency of first member of group 13 of the modern periodic table is four.
R : The first member has only four valence orbitals available for bonding.
10. A : The addition of an electron to $O^-(g)$ is an endothermic process.
R : O^{2-} has stable inert gas electronic configuration.
11. A : Li and Mg show diagonal relationship.
R : Li and Mg are diagonal to one each other in the periodic table.

SECTION-III : Check Your Understanding

PROBLEM 1:

There are different periodic trends with respect to atomic and ionic radii. Size of an atom of a non-metallic element is to measure the distance between two atoms when they are bound together by a single bond in a covalent molecule.

Atomic Radius refer to both covalent or metallic radius depending on whether the element is a non-metal or metal.

The removal of an electron from an atom results in the formation of a cation, whereas gain of an electron leads to an anion. The ionic radii can be estimated by measuring the distances between cations and anions in ionic crystals.

- Which one of the following is correct order of the size of given species?
(1) $I > I^+ > I^-$
(2) $I^- > I > I^+$
(3) $I^+ > I > I^-$
(4) $I^- > I^+ > I$
- Which of the following has the smallest size?
(1) N
(2) B
(3) C
(4) F

- Which of the following order of ionic radii is correctly represented?

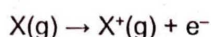
- (1) $O^{2-} > F^- > Na^+ > Mg^{2+}$
- (2) $Mg^{2+} > Na^+ > F^- > O^{2-}$
- (3) $F^- > O^{2-} > Mg^{2+} > Na^+$
- (4) $Na^+ > Mg^{2+} > O^{2-} > F^-$

- The atomic radii of Be and Al respectively are

- (1) 143 pm and 111 pm
- (2) 111 pm and 111 pm
- (3) 111 pm and 143 pm
- (4) 143 pm and 143 pm

PROBLEM 2:

A quantitative measure of the tendency of an element to lose electron is given by its ionization enthalpy. It represents the energy required to remove an electron from an isolated gaseous atom (X) in its ground state. In other words, the first ionization enthalpy for an element X is the enthalpy change ($\Delta_i H$) for the reaction.



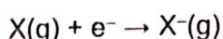
The Ionization enthalpy is expressed in units of kJ mol^{-1}

To understand the trends in Ionization enthalpy, we have to consider two factors

- (i) The attraction of electrons towards the nucleus, and (ii) the repulsion of electrons from each other.
5. Which one of the following arrangements represents the correct order of ionization enthalpy of the given atomic species?
- (1) $\text{Li} < \text{Na} < \text{Rb} < \text{K} < \text{Cs}$
 - (2) $\text{Cs} < \text{Rb} < \text{K} < \text{Na} < \text{Li}$
 - (3) $\text{Rb} < \text{K} < \text{Cs} < \text{Li} < \text{Na}$
 - (4) $\text{K} < \text{Li} < \text{Na} < \text{Rb} < \text{Cs}$
6. With which of the following configuration an atom has the highest ionization enthalpy?
- (1) $1s^2 2s^2 2p^5$
 - (2) $1s^2 2s^2 2p^3$
 - (3) $1s^2 2s^2 2p^4$
 - (4) $1s^2 2s^2 2p^6$
7. The first ionization enthalpies (kJ mol^{-1}) of Be and B respectively are
- (1) 801, 899
 - (2) 899, 801
 - (3) 899, 899
 - (4) 801, 801
8. Among the second period elements, the actual ionization enthalpies are in the order
- (1) $\text{Li} < \text{B} < \text{Be} < \text{C} < \text{O} < \text{N} < \text{F} < \text{Ne}$
 - (2) $\text{B} < \text{Li} < \text{C} < \text{Be} < \text{O} < \text{N} < \text{F} < \text{Ne}$
 - (3) $\text{Li} < \text{B} < \text{C} < \text{Be} < \text{O} < \text{N} < \text{F} < \text{Ne}$
 - (4) $\text{Li} < \text{Be} < \text{B} < \text{C} < \text{N} < \text{O} < \text{F} < \text{Ne}$

PROBLEM 3:

When an electron is added to a neutral gaseous atom (X) to convert it into a negative ion, the enthalpy change accompanying the process is Electron Gain Enthalpy ($\Delta_{\text{eg}}H$). Electron gain enthalpy provides a measure of the ease with which an atom adds an electron to form anion.



Depending on the element, the process of adding an electron to the atom can be either endothermic or exothermic and it is less systematic than for ionization enthalpies.

9. Which among the following will have the highest negative electron gain enthalpy?
- (1) F
 - (2) Cl
 - (3) P
 - (4) S
10. An element with positive electron gain enthalpy is
- (1) O
 - (2) Li
 - (3) Na
 - (4) Ne
11. The element with highest negative electron gain enthalpy will belong to
- (1) Period 2, group 18
 - (2) Period 2, group 17
 - (3) Period 3, group 17
 - (4) Period 2, group 1
12. If IE_1 of Na = 5.1 eV, then the value of electron gain enthalpy of Na^+ is
- (1) + 5.1 eV
 - (2) - 5.1 eV
 - (3) - 10.2 eV
 - (4) + 10.2 eV

Chapter-3 : Classification of Elements and Periodicity in Properties

SECTION-I : NCERT Liners

- | | | |
|-------------------------------|-----------------------------|-----------------------------|
| 1. (T), [NCERT-XI, Pg. 75] | 10. (T), [NCERT-XI, Pg. 82] | 19. (T), [NCERT-XI, Pg. 85] |
| 2. (T), [NCERT-XI, Pg. 75] | 11. (T), [NCERT-XI, Pg. 84] | 20. (T), [NCERT-XI, Pg. 85] |
| 3. (F), [NCERT-XI, Pg. 75-76] | 12. (F), [NCERT-XI, Pg. 84] | 21. (T), [NCERT-XI, Pg. 85] |
| 4. (T), [NCERT-XI, Pg. 76] | 13. (F), [NCERT-XI, Pg. 84] | 22. (F), [NCERT-XI, Pg. 91] |
| 5. (T), [NCERT-XI, Pg. 76] | 14. (T), [NCERT-XI, Pg. 84] | 23. (T), [NCERT-XI, Pg. 92] |
| 6. (T), [NCERT-XI, Pg. 80-81] | 15. (T), [NCERT-XI, Pg. 84] | 24. (T), [NCERT-XI, Pg. 94] |
| 7. (T), [NCERT-XI, Pg. 81] | 16. (F), [NCERT-XI, Pg. 84] | 25. (F), [NCERT-XI, Pg. 94] |
| 8. (T), [NCERT-XI, Pg. 81] | 17. (T), [NCERT-XI, Pg. 84] | 26. (T), [NCERT-XI, Pg. 94] |
| 9. (F), [NCERT-XI, Pg. 82] | 18. (T), [NCERT-XI, Pg. 84] | 27. (T), [NCERT-XI, Pg. 94] |

SECTION-II : Assertion-Reason type

- | | | |
|--------|--------|---------|
| 1. (3) | 5. (2) | 9. (1) |
| 2. (3) | 6. (2) | |
| 3. (1) | 7. (2) | 10. (2) |
| 4. (1) | 8. (1) | 11. (2) |

SECTION-III : Check Your Understanding

1. Answer (2)

- A cation is smaller than its parent atom because of increase in effective nuclear charge in case of cation. So, I^+ is smaller than I .
- While, an anion is larger than its parent atom due to decrease in Z_{eff} in case of anion. So, I^- is larger than I .

The correct order of size is $I^- > I > I^+$

2. Answer (4)

The atomic size generally decreases across a period as the atomic number increases resulting in the increased attraction of electrons to the nucleus.

3. Answer (1)

Na^+ , Mg^{2+} , F^- and O^{2-} have same number of electrons but different nuclear charges.

- The cation with greater positive charge will have a smaller radius because of the greater attraction of the electrons to the nucleus.
- While, anion with greater negative charge will have the largest radius.

4. Answer (3)

Atomic radius of Al is greater than Be .

Atomic radius of $Al = 143 \text{ pm}$ and atomic radius of $Be = 111 \text{ pm}$.

5. Answer (2)

As we go down the group, the outermost electron being increasingly farther from the nucleus and removal of the outermost electron requires less energy as we move down across the group.

6. Answer (4)

Because of stable electronic configurations, noble gases have highest ionisation enthalpy in respective period.

So, an atom having electronic configuration $1s^2 2s^2 2p^6$ has highest ionisation enthalpy.

7. Answer (2)

It is easier to remove the $2p$ -electron from boron compared to the removal of a $2s$ -electron from beryllium. Thus, Boron has a smallest first ionization enthalpy than beryllium.

8. Answer (1)

Across a period, in general ionization enthalpy increases as outermost electrons are held more and more tightly.

But, the first ionization enthalpy of B is less than Be as it is easier to remove the $2p$ -electron from boron compared to the removal of a $2s$ -electron from beryllium.

Similarly, the first ionization enthalpy of O is less than N because it is easier to remove the fourth $2p$ -electron from oxygen than it is, to remove one of the three $2p$ -electrons from nitrogen as electron-electron repulsion is greater in case of oxygen.

9. Answer (2)

Electron gain enthalpy generally becomes more negative across a period as we move from left to right. Within a group, electron gain enthalpy becomes less negative down the group.

Adding an electron to the $2p$ -orbital leads to greater repulsion than an electron to the larger $3p$ -orbital. Hence the element with most negative electron gain enthalpy is chlorine.

10. Answer (4)

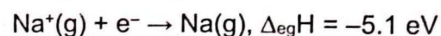
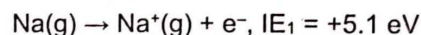
Noble gases have large positive electron gain enthalpies because electron has to enter the next higher principal quantum level leading to a very unstable electronic configuration.

11. Answer (3)

Group 17 elements (halogens) have very high negative electron gain enthalpies because they can attain stable noble gas electronic configuration by picking up an electron.

However, electron gain enthalpy is more negative in case of third period element than second period element as the added electron goes to $n = 3$ quantum number suffers much less electron-electron repulsion than $n = 2$ quantum number.

12. Answer (2)



Chemical Bonding and Molecular Structure

4

Chapter

Marking Scheme

- For every correct answer you earn four marks (+4).
- For every incorrect answer you lose one mark (-1).

Marks Obtained		Percentage Score
Maximum Marks	208	

SECTION-I : NCERT Liners

Choose whether the statement is True (T) or False (F).

- | | T | F |
|---|--------------------------|--------------------------|
| 1. According to Kossel, in the periodic table, the highly electronegative halogens and highly electropositive alkali metals are separated by the noble gases. | ☐ | ☐ |
| 2. In carbon dioxide, the total number of lone pair of electrons on both the oxygen atoms and on the carbon atom are 4 and 0 respectively. | ☐ | ☐ |
| 3. Sulphur atom in sulphur dichloride does not have complete octet though it is stable. | ☐ | ☐ |
| 4. Electron gain process is always exothermic while process of ionisation is always endothermic. | ☐ | ☐ |
| 5. In ionic compounds, crystal structure gets stabilised due to the energy released in the formation of lattice enthalpy. | ☐ | ☐ |
| 6. Covalent radius of an atom, is always larger than its van der Waals radius. | ☐ | ☐ |
| 7. Larger the bond dissociation enthalpy, stronger will be the bond in the molecule. | ☐ | ☐ |
| 8. Enthalpy needed to break the two O-H bonds in water molecule is not same. | ☐ | ☐ |
| 9. N_2 , CO and NO^+ have same bond order. | ☐ | ☐ |
| 10. The bond length of two O-O bonds in resonance hybrid of ozone molecule is equal but smaller than both the O-O bond lengths of canonical forms. | ☐ | ☐ |
| 11. Hydrogen molecule is a covalent species in which there is no ionic character. | ☐ | ☐ |
| 12. In the formation of π bond, the atomic orbitals overlap in such a way that their axes and internuclear axis remain perpendicular to each other. | ☐ | ☐ |
| 13. Ethyne is the molecule with equal number of σ and π bonds. | ☐ | ☐ |
| 14. Atomic orbitals of proper symmetry and comparable energies combine to form molecular orbitals. | ☐ | ☐ |
| 15. Li_2 is diamagnetic and exists in vapour phase. | ☐ | ☐ |
| 16. The examples of the molecules showing intra molecular hydrogen bonding are HF molecule, alcohol and water. | ☐ | ☐ |

17. Formation of AlCl_4^- from AlCl_3 results in change in hybridisation from sp^2 to sp^3 .
18. Nitrogen does not form NCl_5 due to the absence of d orbitals.
19. Water molecule, has sp^3 hybridised oxygen atom with bond angle of 109.5° .
20. BeCl_2 molecule has hybrid orbitals with 50% s character as well as a linear geometry.
21. Formal charge on central atom of ozone molecule is zero.
22. SF_6 and NO are the examples of expanded octet and odd electron molecules respectively.
23. Lattice enthalpy is a quantitative measure of stability of a compound.
24. Carbon dioxide has three canonical forms and zero dipole moment.
25. 1, 2, 4- Trichlorobenzene is a non-polar molecule.
26. SF_4 has a folded square shape.
27. p_x and p_y orbitals have different orientation and this results in zero overlap.
28. The value of bond enthalpy increases as the bond length of the molecule decreases.

SECTION-II : Assertion-Reason type

In the following questions, a statement of assertion (A) is followed by a statement of reason (R).

- (1) If both Assertion & Reason are true and the Reason is the correct explanation of the Assertion, then mark (1).
- (2) If both Assertion & Reason are true but the Reason is not the correct explanation of the Assertion, then mark (2).
- (3) If Assertion is true statement but Reason is false, then mark (3).
- (4) If both Assertion & Reason are false statements, then mark (4).

- | | |
|--|---|
| 1. A : $2p_z$ orbital of one atom cannot combine with the $2p_x$ or $2p_y$ orbital of the another atom. | depending upon the number of atoms in a molecule. |
| R : $2p_z$ orbital and $2p_x$ or $2p_y$ orbitals have different orientation. | |
| 2. A : Sigma bond is stronger as compared to the pi bond. | |
| R : Extent of overlapping of orbitals in case of sigma bond is larger than that of pi bond. | |
| 3. A : An atomic orbital is monocentric while a molecular orbital is polycentric. | |
| R : An electron in an atomic orbital is influenced by one nucleus whereas in a molecular orbital, it is influenced by two or more nuclei | |
| 4. A : H_2O is a liquid while H_2S is a gas. | |
| R : Small size and high electronegativity of oxygen atom leads to high intermolecular hydrogen bonding. | |
| 5. A : CsCl is more ionic than NaCl . | |
| R : Cs^+ has larger size than Na^+ . | |
| 6. A : Generally, the lowest energy structure of a molecule is the one with the smallest formal charges on the atoms. | |
| R : Formal-charge helps in the selection of the lowest energy structure. | |

7. A: The hybrid orbitals are more effective in forming stable bond than pure atomic orbitals.
R: The number of hybrid orbitals is equal to the number of the atomic orbitals that get hybridised.
8. A: H_2O and XeF_4 both have plane of symmetry.
R: H_2O is polar molecule whereas XeF_4 is non-polar molecule.
9. A: Oxygen-oxygen bond lengths in O_3 molecule are intermediate between a double and single bond.
R: O_3 molecule is resonance hybrid of two canonical forms.
10. A: Ionisation potential of Be is more than that of B.
R: The first electron released for Be is from filled s -orbital but that for B is from partially filled p -orbital.
11. A: BF_3 is planar while NH_3 is pyramidal.
R: B in BF_3 is sp^2 hybridised with no lone pair but N in NH_3 is sp^3 hybridized with one lone pair of electron.
12. A: Generally ionic salt does not dissolve in non-polar solvent.
R: In case of a non-polar (covalent) solvent, solvation enthalpy is small and hence not sufficient to overcome lattice enthalpy of the ionic compound.

SECTION-III : Check Your Understanding

PROBLEM 1:

Consider the given table and choose the correct answer for the following questions.

Shape of molecules/ions	Hybridisation type	Atomic orbitals
Square planar	dsp^2	$d + s + p(2)$
Trigonal bipyramidal	sp^3d	$s + p(3) + d$
Square pyramidal	sp^3d^2	$s + p(3) + d(2)$
Octahedral	sp^3d^2 d^2sp^3	$s + p(3) + d(2)$ $d(2) + s + p(3)$

1. Which of the following species has same shape as that is of $[\text{Ni}(\text{CN})_4]^{2-}$?
- CH_4
 - NH_4^+
 - SF_4
 - XeF_4
2. The pair of species which have same hybridisation and different shape is
- SF_6 and $[\text{CrF}_6]^{3-}$
 - PF_5 and BrF_5
 - SF_6 and BrF_5
 - PF_5 and $[\text{CrF}_6]^{3-}$

3. Select the correct statement from the following.

- In PCl_5 , 4 P-Cl bonds lie in one plane and make an angle of 90° while one bond is above the equatorial plane at an angle of 90°
- Bond pairs at equatorial position suffer more repulsive interaction than axial bonds
- PCl_5 molecule becomes more reactive due to weaker axial bonds
- Bond dipole of all 5 P-Cl bonds is equal in PCl_5

PROBLEM 2:

Consider the following table for the diatomic molecules named as 1, 2, 3, 4, 5 and 6 and the formula of bond order.

Bond order = $\frac{1}{2}(\text{Nb} - \text{Na})$ where Na = Number of electrons in antibonding MO, Nb = Number of electrons in bonding MO.



On the basis of the given table, choose the correct option for the following questions

4. Choose the pair of molecules which have similarity in magnetic nature and same energies of their π $2p_x$ molecular orbitals.

(1) 2 and 3

(2) 3 and 4

(3) 4 and 5

(4) 2 and 5

5. Identify molecules 3, 4, 5 and 6 on the basis of electronic configuration and choose the incorrect statement from the following

(1) Molecule '4' is O_2 and its superoxide ion has bond order 1.5

(2) Molecule '5' is diamagnetic but its uninegative ion will be paramagnetic with bond order 0.5

(3) Unipositive ion of '3' has paramagnetic nature with bond order 1.5

(4) Possibility of formation of diatomic molecule 6 is negligible as its bond order is zero

6. Which of the following is correct corresponding to molecule 2?

(1) It is paramagnetic

(2) It has 6 electrons in bonding molecular orbitals

(3) Because of the presence of four electrons in 2π molecular orbitals, molecule '2' consists of only pi bonds

(4) Formation of dipositive cation by it, does not change its magnetic behaviour and bond order

PROBLEM 3:

Dipole moment is a vector quantity that not only depend upon individual bond dipoles but also on the spatial arrangement of various bonds in the molecule.

The dipole moment of a molecule is the vector sum of the dipole moments of various bonds. Now, answer the following questions.

7. Which of the following set of molecules have zero dipole moment?

(1) CO_2 , HI, BF_3 , H_2

(2) CCl_4 , BF_3 , CO_2 , CH_4

(3) H_2 , HF, $CHCl_3$, CH_4

(4) CH_4 , CCl_4 , CO_2 , HBr

8. The correct order of increasing value of dipole moment of the following species is

(1) $H_2O < NF_3 < NH_3$

(2) $H_2O < NH_3 < NF_3$

(3) $NH_3 < NF_3 < H_2O$

(4) $NF_3 < NH_3 < H_2O$

9. Consider the following statements and choose the correct option.

Statement I: A polyatomic molecule can have zero dipole moment.

Statement II: It is necessary for a polyatomic molecule to have linear geometry to exhibit dipole moment zero

(1) Statement I is correct and statement II is incorrect

(2) Statement II is correct and statement I is incorrect

(3) Both the statements are correct

(4) Both the statements are incorrect

PROBLEM 4:

Analyse the given molecules and respective arrangement of their electron pairs around central atom.

Arrangement of electron pairs	Total number of bonding pair and lone pairs
Trigonal Planar	3
Tetrahedral	4
Trigonal Bipyramidal	5
Octahedral	6

Now, answer the following questions:

10. Consider the given statements and choose the correct one.

- (1) XeF_4 is a molecule which has square pyramid geometry due to the presence of lone pair on Xe atom
- (2) BrF_5 has a regular trigonal bipyramidal shape due to the presence of 5 bond pairs on it
- (3) Octahedral arrangement of electron pairs around central atom can lead to the formation of 2 shapes i.e. square pyramidal and trigonal bipyramidal
- (4) Lone pair of electrons around central atom are less in square pyramid than those in square planar

11. Match the following columns and choose the correct answer.

	Column I (Molecule)		Column II (Shape)
(i)	ClF_3	a.	Bent
(ii)	SO_2	b.	See-saw
(iii)	SF_4	c.	Trigonal Pyramidal
(iv)	NF_3	d.	T-shape

- (1) (i)d, (ii)c, (iii)b, (iv)a
- (2) (i)d, (ii)a, (iii)c, (iv)d
- (3) (i)d, (ii)a, (iii)b, (iv)c
- (4) (i)a, (ii)d, (iii)b, (iv)c

12. Choose the species from the following with planer shape and maximum number of lone pair of electrons around central atom.

- | | |
|--------------------|--------------------------|
| (1) SF_4 | (2) H_2O |
| (3) ClF_3 | (4) XeF_2 |

□ □ □

Chapter-4 : Chemical Bonding and Molecular Structure

SECTION-I : NCERT Liners

- | | | |
|-------------------------------|-------------------------------|------------------------------------|
| 1. (T), [NCERT-XII, Pg. 101] | 11. (F), [NCERT-XII, Pg. 110] | 21. (F), [NCERT-XII, Pg. 105] |
| 2. (T), [NCERT-XII, Pg. 104] | 12. (F), [NCERT-XII, Pg. 120] | 22. (T), [NCERT-XII, Pg. 105] |
| 3. (F), [NCERT-XII, Pg. 106] | 13. (F), [NCERT-XII, Pg. 124] | 23. (T), [NCERT-XII, Pg. 107] |
| 4. (F), [NCERT-XII, Pg. 106] | 14. (T), [NCERT-XII, Pg. 125] | 24. (T), [NCERT-XII, Pg. 110, 111] |
| 5. (T), [NCERT-XII, Pg. 106] | 15. (T), [NCERT-XII, Pg. 130] | 25. (F), [NCERT-XII, Pg. 111] |
| 6. (F), [NCERT-XII, Pg. 107] | 16. (F), [NCERT-XII, Pg. 132] | 26. (T), [NCERT-XII, Pg. 116] |
| 7. (T), [NCERT-XII, Pg. 108] | 17. (T), [NCERT-XII, Pg. 135] | 27. (T), [NCERT-XII, Pg. 119] |
| 8. (T), [NCERT-XII, Pg. 108] | 18. (T), [NCERT-XI, Pg. 124] | 28. (T), [NCERT-XII, Pg. 118] |
| 9. (T), [NCERT-XII, Pg. 109] | 19. (F), [NCERT-XII, Pg. 122] | |
| 10. (F), [NCERT-XII, Pg. 109] | 20. (T), [NCERT-XII, Pg. 121] | |

SECTION-II : Assertion-Reason type

- | | | |
|--------|--------|---------|
| 1. (1) | 5. (2) | 9. (1) |
| 2. (1) | 6. (2) | 10. (1) |
| 3. (1) | 7. (2) | 11. (1) |
| 4. (1) | 8. (2) | 12. (1) |

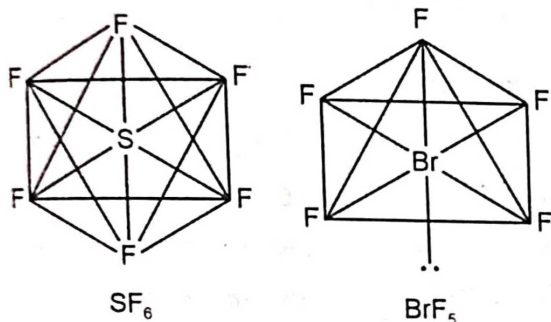
SECTION-III : Check Your Understanding

1. Answer (4)

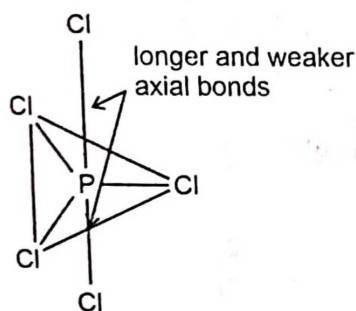
$[\text{Ni}(\text{CN})_4]^{2-}$ has square planar shape as its hybridisation is dsp^2 and same shape as XeF_4

2. Answer (3)

Central atoms of both BrF_5 and SF_6 are sp^3d^2 hybridised but due to the presence of lone pair on central atom and 5 Fluorine atoms, BrF_5 has square pyramidal shape instead of octahedral.



3. Answer (3)



As all the P-Cl bonds are not equal so, their bond polarities will also be different.

4. Answer (1)

Element 2 and 3 both are diamagnetic due to the absence of unpaired electron(s). Also their $\pi 2p_x$ molecular orbitals have same energies.

5. Answer (3)

Molecules 1, 2, 3, 4, 5, 6 are B_2 , C_2 , N_2 , O_2 , F_2 and Ne_2 respectively superoxide ion O_2^- has bond order $= \frac{1}{2}(10 - 7) = 1.5$

F_2 is diamagnetic while F_2^- is paramagnetic with

$$\text{B.O.} = \frac{1}{2}(10 - 9) = 0.5$$

N_2^+ has B.O. $= \frac{1}{2}(9 - 4) = 2.5$ while Ne_2 has

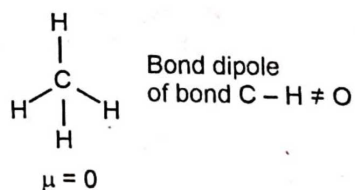
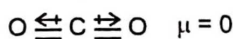
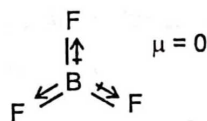
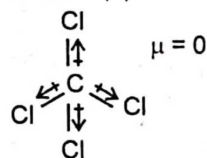
$$\text{B.O.} = \frac{1}{2}(10 - 10) = 0$$

6. Answer (3)

Molecule 2 is C_2 (B.O. = 2) which is diamagnetic and consists of only π bonds.

C_2^{2+} ion will be paramagnetic with bond order 1.

7. Answer (2)



8. Answer (4)

Dipole moment depends on 2 factors 1-Bond dipole (based on electronegativity difference) 2-Spatial arrangement of various bonds in molecule

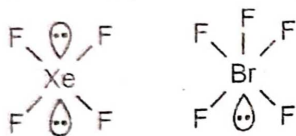
The values of dipole moments are as follows

H ₂ O	-	1.85
NH ₃	-	1.47
NF ₃	-	0.23

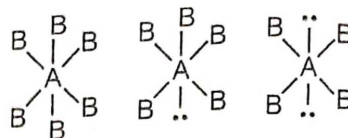
9. Answer (1)

It is not necessary for a polyatomic molecule to be linear to show zero dipole moment, molecules like CH₄, BF₃ etc are not linear but have zero dipole moment.

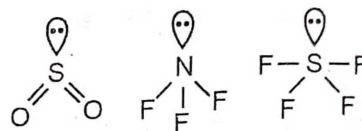
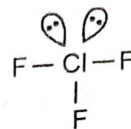
10. Answer (4)



Octahedral arrangement of electrons can lead to the multiple shapes like square pyramidal, square planar and regular octahedron etc.



11. Answer (3)



12. Answer (4)

XeF₄ molecule is square planar with 2 lone pair of electrons.

1. For every correct answer you earn four marks (+4).
2. For every incorrect answer you lose one mark (−1).

$\frac{\text{Marks Obtained}}{\text{Maximum Marks}} = \frac{\quad}{184}$	Percentage Score
--	------------------

Choose whether the statement is True (T) or False (F).

1. Ion-dipole forces are not van der Waals forces.
2. At a particular temperature the individual speed of molecules keeps changing.
3. Particles of a gas move in all possible directions in straight lines.
4. van der Waals constant 'a' depends on temperature and pressure of the gas.
5. Equal weights of gases in a non-reacting mixture, always exert equal pressure.
6. van der Waals gas equation for 1 mole of real gas is
$$\left(P + \frac{a}{V^2}\right)(V - b) = RT$$
7. The temperature at which a real gas obeys ideal gas law over an appreciable range of pressure is called critical temperature.
8. Gases having $Z > 1$, are more difficult to compress.
9. On doubling the pressure, the density of gas gets doubled, at constant temperature.
10. Surface tension is the energy required to increase the surface area of liquid by one unit.
11. A real gas shows ideal behaviour at high pressure and low temperature.
12. Equal volume of O_2 and O_3 under the same condition of temperature and pressure contain unequal number of molecules.
13. Value of universal gas constant 'R' is $8.314 \text{ L-atm mol}^{-1} \text{ K}^{-1}$
14. Glass is an extremely viscous liquid.
15. Greater is the value of van der Waals constant 'a', more difficult is to liquify the gas.
16. At a given temperature ratio of v_{mp} to v_{av} is $1.128 : 1$

17. In order to decrease the volume of an ideal gas by 20%, pressure of the gas has to be increased by 20% at constant temperature
18. The ratio of volumes of ideal gas at $t^{\circ}\text{C}$ and 0°C is $\left(1 + \frac{t}{273.15}\right)$.
19. The volume of 1 mol of real gas at STP having $Z = 2$ is 22.4 L.
20. Pay load is defined as the difference between the mass of displaced air and the mass of balloon.

SECTION-II : Assertion-Reason type

In the following questions, a statement of assertion (A) is followed by a statement of reason (R).

- (1) If both Assertion & Reason are true and the Reason is the correct explanation of the Assertion, then mark (1).
- (2) If both Assertion & Reason are true but the Reason is not the correct explanation of the Assertion, then mark (2).
- (3) If Assertion is true statement but Reason is false, then mark (3).
- (4) If both Assertion & Reason are false statements, then mark (4).

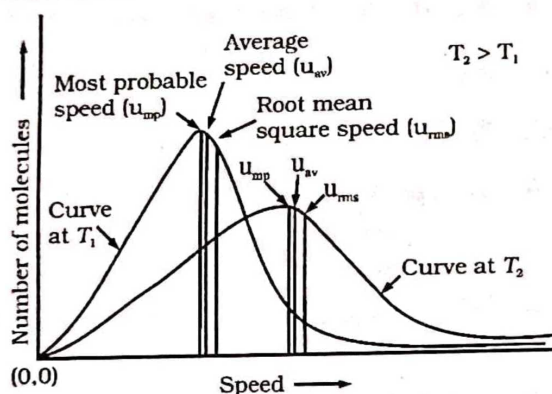
1. A : At absolute temperature the volume of gas approaches zero.
R : According to Charles' law volume is directly proportional to absolute temperature.
2. A : NH_3 is easily liquefied than N_2 .
R : The value of 'a' is larger for NH_3 .
3. A : Above critical temperature liquid phase does not exist.
R : A gas below its critical temperature is called vapour.
4. A : One mole of $\text{N}_2(\text{g})$ and $\text{O}_2(\text{g})$ each occupy 22.4 L of volume at 0°C and one atm pressure.
R : Molar volume of any ideal gas at the same temperature and pressure has the same volume.
5. A : Gases become denser at high pressure.
R : At a constant temperature, pressure is directly proportional to the density of a fixed mass of the gas.
6. A : Surface tension of liquid decreases as temperature increases.
R : With increase in temperature, effectiveness of intermolecular attraction decreases.
7. A : van der Waals constant a is the measure of magnitude of intermolecular attractive forces between gas molecules.
R : van der Waals constant a is independent of temperature and pressure.
8. A : Pressure exerted by gas in a closed container increases with increasing temperature of gas.
R : With the rise in temperature, the average speed of gas molecules increases.
9. A : Vapour pressure of liquid increases with increase in temperature.
R : At elevated temperature, kinetic energy of liquid molecules increases.
10. A : Liquids at high altitudes boil at lower temperature in comparison to that at sea level.
R : At high altitudes atmosphere pressure is low.
11. A : Boyle temperature (T_b) is given by $T_b = \frac{a}{Rb}$.
R : Gases with large value of a are easily liquefiable.

12. A : The condition of free vaporization throughout the liquid is called boiling.
 R : The temperature at which vapour pressure of liquid is equal to that of external pressure is called boiling point at that pressure.
13. A : Real gases show ideal behaviour when conditions of temperature and pressure are such that the intermolecular forces are practically negligible.
 R : The deviation from ideal behaviour of a real gas measured in terms of compressibility factor Z .

14. A : If the system is in the thermal equilibrium with the surrounding, then the temperature of the surrounding is same as that of the system.
 R : If a reaction has a positive enthalpy change and negative entropy change, it can never be spontaneous.
15. A : Liquid tends to rise in the capillary.
 R : Liquid has surface tension.

SECTION-III : Check Your Understanding

PROBLEM 1:



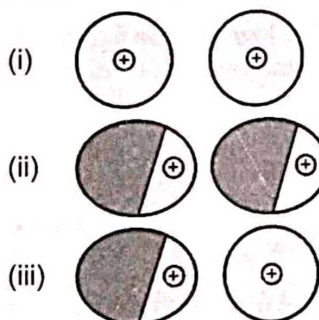
Maxwell-Boltzmann distribution of speeds

On the basis of above diagram, choose the correct option for the following questions.

- Select the incorrect statement from the following
 - The speeds of all the molecules of the gas at any instant are not the same
 - Fraction of molecules possessing very high speed is very large
 - Speed distribution curve broadens at higher temperature
 - Molecular speeds depend on temperature and molecular mass of the gas
- Select the correct order of molecular speed at a given temperature
 - $U_{av} > U_{rms} > U_{mp}$
 - $U_{rms} > U_{av} > U_{mp}$
 - $U_{mp} > U_{rms} > U_{av}$
 - $U_{av} > U_{mp} > U_{rms}$

- On increasing the temperature the number of molecules having most probable speed.
 - Remains same
 - Increases
 - Decreases
 - First increases then decreases

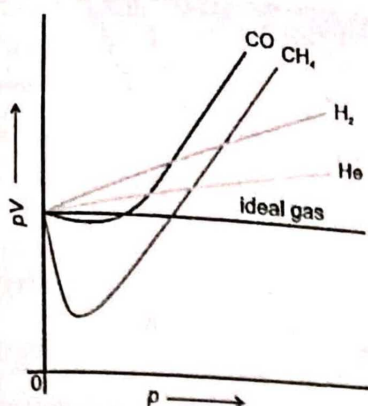
PROBLEM 2:



On the basis of above diagram, choose the correct option for the following questions.

- In which of the following species, primary force of attraction are London forces?
 - CCl_4
 - H_2O
 - HCl
 - NaCl
- In which of the following molecules symmetrical distribution of electronic charge cloud is possible?
 - HF
 - NH_3
 - CH_4
 - CaCO_3

PROBLEM 3:



On the basis of above diagram, choose the correct options for the following questions.

6. Which of the following gas is most compressible at low pressure?

- (1) He (2) H₂
(3) CH₄ (4) CO

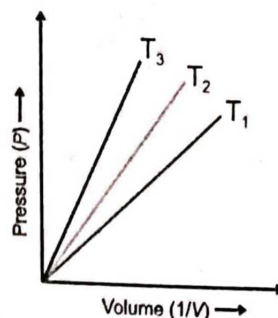
7. Select the incorrect statement among the following

- (1) H₂ gas shows negative deviation from ideal behaviour at all pressure
(2) CO gas shows negative deviation from ideal behaviour at low pressure
(3) CH₄ gas shows positive deviation from ideal behaviour at high pressure
(4) At any pressure He is less compressible than ideal gas

8. For which of the following, pV can be less than nRT ?

- (1) Ideal gas (2) CO
(3) H₂ (4) He

PROBLEM 4:



On the basis of above diagram, choose the correct option for the following questions.

9. If volume of gas is increased by 2 times at constant temperature then pressure of the gas will be

- (1) Become one fourth
(2) Remain unchanged
(3) Increased by 2 times
(4) Become halved

10. In the above graph, select the correct order of temperature.

- (1) $T_1 > T_2 > T_3$
(2) $T_3 > T_2 > T_1$
(3) $T_2 > T_1 > T_3$
(4) $T_2 > T_3 > T_1$

11. At constant temperature, among which of the following variables, the graph formed is not linear?

- (1) P vs $\frac{1}{V}$
(2) PV vs P
(3) P vs V
(4) PV vs V

Chapter-5 : States of Matter

SECTION-I : NCERT Liners

- | | | |
|-----------------------------|------------------------------|------------------------------|
| 1. (T), [NCERT-XI, Pg. 137] | 8. (T), [NCERT-XI, Pg. 151] | 15. (F), [NCERT-XI, Pg. 154] |
| 2. (T), [NCERT-XI, Pg. 148] | 9. (T), [NCERT-XI, Pg. 146] | 16. (F), [NCERT-XI, Pg. 149] |
| 3. (T), [NCERT-XI, Pg. 149] | 10. (F), [NCERT-XI, Pg. 156] | 17. (F), [NCERT-XI, Pg. 140] |
| 4. (F), [NCERT-XI, Pg. 151] | 11. (F), [NCERT-XI, Pg. 151] | 18. (T), [NCERT-XI, Pg. 142] |
| 5. (F), [NCERT-XI, Pg. 147] | 12. (F), [NCERT-XI, Pg. 144] | 19. (F), [NCERT-XI, Pg. 152] |
| 6. (T), [NCERT-XI, Pg. 151] | 13. (F), [NCERT-XI, Pg. 145] | 20. (T), [NCERT-XI, Pg. 158] |
| 7. (F), [NCERT-XI, Pg. 152] | 14. (T), [NCERT-XI, Pg. 157] | |

SECTION-II : Assertion-Reason type

- | | | |
|--------|---------|---------|
| 1. (1) | 6. (1) | 11. (2) |
| 2. (1) | 7. (2) | 12. (2) |
| 3. (2) | 8. (1) | 13. (2) |
| 4. (1) | 9. (1) | 14. (2) |
| 5. (1) | 10. (1) | 15. (1) |

SECTION-III : Check Your Understanding

- | | |
|---|---|
| 1. Answer (2)
Fraction of molecules with very high and very low speed is very small. | 2. Answer (2)
Correct order of molecular speeds is $U_{rms} > U_{av} > U_{mp}$. |
|---|---|

3. Answer (3)

On increasing temperature fraction of molecules having most probable speed decreases.

4. Answer (1)

In non polar molecules, primary forces are London forces.

5. Answer (3)

In CH_4 , all four bond pairs are present with no lone pair, so, electron are symmetrically distributed around carbon atom.

6. Answer (3)

CH_4 follows highest negative deviation from ideal behaviour due to strong intermolecular interaction between CH_4 molecules compared to other gases.

7. Answer (1)

For H_2 and He gas, van der Waals constant b is always dominating than ' a ' hence z is always greater than 1 ($Z > 1$) at all pressure range.

8. Answer (2)

For gases like CO and CH_4 , pV vs p plot shows negative deviation from ideal behaviour, the pV value decreases with increase in pressure. so, $pV < nRT$ at low pressure.

9. Answer (4)

At constant temperature, the pressure of a fixed amount of gas varies inversely with its volume

$$P \propto \frac{1}{V} \text{ (at constant T and n)}$$

10. Answer (2)

The graph between P vs $\frac{1}{V}$ is a straight line passing through origin. At constant ' V ', as pressure increases temperature also increases.

11. Answer (3)

At constant temperature, $P \propto \frac{1}{V}$

$$P = k_1 \frac{1}{V}$$

$PV = k_1$, P vs V follows rectangular hyperbola

1. For every correct answer you earn four marks (+4).
2. For every incorrect answer you lose one mark (-1).

Marks Obtained	= 160	Percentage Marks
Maximum Marks		

Choose whether the statement is True (T) or False (F).

1. For one mole of ideal gas, $C_V = C_P - R$.
2. No work is done during free expansion of an ideal gas.
3. Heat absorbed by the system at constant pressure is equal to the change in internal energy of the system.
4. Standard enthalpy of fusion for melting of ice is positive.
5. The standard molar enthalpy of formation ($\Delta_f H^\circ$) is zero for $\text{Cl}_2(\text{g})$ but non-zero for $\text{Br}_2(\text{g})$.
6. Entropy is maximum for a system in equilibrium.
7. Entropy of any pure crystalline substance approaches zero as temperature approaches absolute zero.
8. For reversible expansion of an ideal gas under isothermal condition, $\Delta U = 0$.
9. $\Delta_r H^\circ = \Delta_f H^\circ (\text{CaCO}_3(\text{s}))$ for $\text{CaO}(\text{s}) + \text{CO}_2(\text{g}) \rightarrow \text{CaCO}_3(\text{s})$.
10. Tea placed in a thermos flask is an example of closed system.
11. For adiabatic process, the change in internal energy determines the amount of work done by the system.
12. $\Delta H = \Delta U$ for $\text{C}(\text{s}) + 2\text{H}_2\text{O}(\text{g}) \rightarrow 2\text{H}_2(\text{g}) + \text{CO}_2(\text{g})$
13. A reaction is spontaneous at only high temperature when ΔH and ΔS both are positive.
14. Standard enthalpy of combustion is defined as the enthalpy change of a substance, when reactants undergoes combustion and produces one mole of products present in their standard states at the specified temperature.
15. Specific heat capacity is the quantity of heat required to raise the temperature of one unit mass of a substance by one degree Celsius.

16. Bomb calorimeter is used to determine change in internal energy for chemical reactions.
17. Third law of thermodynamics is applicable to pure crystalline substances.
18. Free energy of a system is minimum at equilibrium.
19. First law of thermodynamics states that the energy of an isolated system is constant.
20. Reversible process tends to complete in finite time.

SECTION-II : Assertion-Reason type

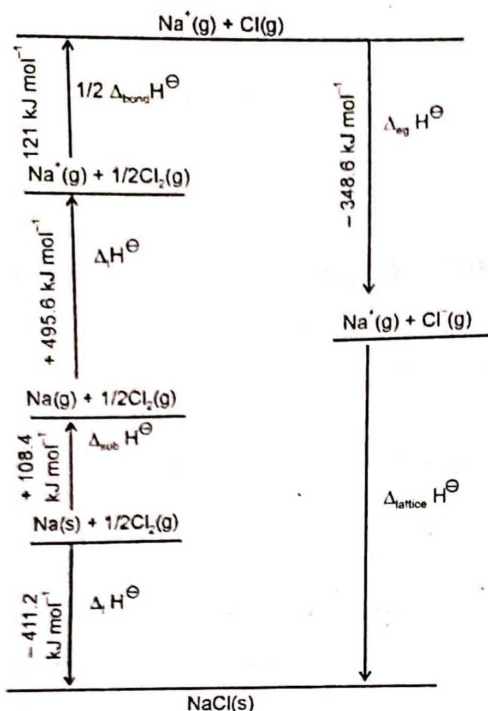
In the following questions, a statement of assertion (A) is followed by a statement of reason (R).

- (1) If both Assertion & Reason are true and the Reason is the correct explanation of the Assertion, then mark (1).
- (2) If both Assertion & Reason are true but the Reason is not the correct explanation of the Assertion, then mark (2).
- (3) If Assertion is true statement but Reason is false, then mark (3).
- (4) If both Assertion & Reason are false statements, then mark (4).

- | | |
|---|---|
| <p>1. A: Variables like P, V, T are called state functions.
R: Their values depend only on the state of the system and not on how it is reached.</p> <p>2. A: Less heat is required to vaporise 1 mole of acetone than to vaporise 1 mole of water.
R: Molecular mass of acetone is higher than the molecular mass of water.</p> <p>3. A: Heat (q) has randomising influence on the system.
R: Whenever heat is added to the system, it increases molecular motions causing increased randomness in the system.</p> <p>4. A: The internal energy change during reversible isothermal expansion of an ideal gas is zero.
R: Change in internal energy is the function of temperature.</p> <p>5. A: Thermodynamic properties are macroscopic in nature.
R: Law of thermodynamics apply only when a system is in equilibrium or moves from one equilibrium state to another equilibrium state.</p> | <p>6. A: $\Delta H_{\text{reaction}}$ is negative for exothermic reaction.
R: Enthalpy of reactants is greater than enthalpy of products in an exothermic reactions.</p> <p>7. A: For adiabatic process, $\Delta U = W$.
R: In an adiabatic process, no heat is transferred between the system and surrounding.</p> <p>8. A: A spontaneous process is irreversible and may only be reversed by some external agency.
R: Total entropy change of a spontaneous process is positive.</p> <p>9. A: Heat absorbed or evolved in a system is $Q = C\Delta T$.
R: The magnitude of rise in temperature depends on the heat capacity (C) of a substance.</p> <p>10. A: Pressure is an intensive property.
R: Volume is an extensive property.</p> |
|---|---|

SECTION-III : Check Your Understanding

PROBLEM 1:



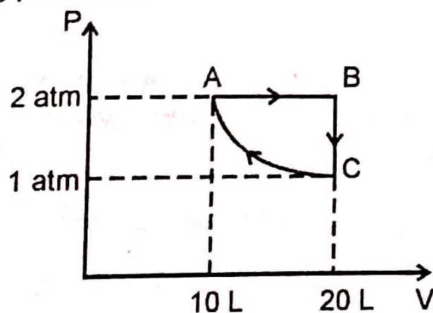
Enthalpy diagram for lattice enthalpy of NaCl

On the basis of above diagram answer the following questions.

- The $\Delta_{\text{lattice}}H^\circ$ for $\text{Na}^+\text{Cl}^-(\text{s}) \rightarrow \text{Na}^+(\text{g}) + \text{Cl}^-(\text{g})$ in Born-Haber cycle is
 (1) $1485.2 \text{ kJ mol}^{-1}$ (2) $-787.6 \text{ kJ mol}^{-1}$
 (3) $-1485.2 \text{ kJ mol}^{-1}$ (4) $787.6 \text{ kJ mol}^{-1}$
- The standard enthalpy of solution ($\Delta_{\text{sol}}H^\circ$) for one mole of $\text{NaCl}(\text{s})$ when $\Delta_{\text{hyd}}H^\circ = -783.6 \text{ kJ mol}^{-1}$, is
 (1) 15 kJ mol^{-1} (2) 4 kJ mol^{-1}
 (3) -15 kJ mol^{-1} (4) -4 kJ mol^{-1}

PROBLEM 2:

One mole of a perfect ideal gas undergoes the following processes.



Answer the following questions:

- The line AB in the above P-V diagram represents
 (1) Isobaric expansion
 (2) Isochoric change
 (3) Isothermal expansion
 (4) Adiabatic expansion
- Which among the following property is not zero for the overall process?
 (1) ΔU (2) q
 (3) ΔS (4) ΔH
- The total work done involved in the overall process is
 (1) 25.16 L atm (2) -25.16 L atm
 (3) -6.14 L atm (4) $+6.14 \text{ L atm}$

PROBLEM 3:

Consider the table given below and answer the following questions.

Standard enthalpy changes of fusion and vaporisation

Substance	T_f/K	$\Delta_{\text{fus}}H^\circ / (\text{kJ mol}^{-1})$	T_b/K	$\Delta_{\text{vap}}H^\circ / (\text{kJ mol}^{-1})$
N_2	63.15	0.72	77.35	5.59
NH_3	195.40	5.65	239.73	23.35
HCl	159.0	1.992	188.0	16.15
CO	68.0	6.836	82.0	6.04
CH_3COCH_3	177.8	5.72	329.4	29.1
CCl_4	250.16	2.5	349.69	30.0
H_2O	273.15	6.01	373.15	40.79
NaCl	1081.0	28.8	1665.0	170.0
C_6H_6	278.65	9.83	353.25	30.8

(T_f and T_b are melting and boiling points, respectively)

- Which among the following has the strongest intermolecular forces of attractions?
 (1) NH_3 (2) H_2O
 (3) C_6H_6 (4) CCl_4
- The entropy of fusion ($\Delta_{\text{fus}}S$) for $\text{C}_6\text{H}_6(\text{s}) \rightarrow \text{C}_6\text{H}_6(\text{l})$ is
 (1) $28.34 \text{ J mol}^{-1} \text{ K}^{-1}$ (2) $27.39 \text{ J mol}^{-1} \text{ K}^{-1}$
 (3) $20.5 \text{ J mol}^{-1} \text{ K}^{-1}$ (4) $35.27 \text{ J mol}^{-1} \text{ K}^{-1}$

PROBLEM 4:

Consider the table given below and answer the following questions

Effect of temperature on spontaneity of reactions

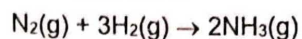
$\Delta_r H^\ominus$	$\Delta_r S^\ominus$	$\Delta_r G^\ominus$
-	+	-
-	-	- (at low T)
-	-	+ (at high T)
+	+	+ (at low T)
+	+	- (at high T)
+	-	+ (at all T)

The term low temperature and high temperature are relative. For a particular reaction, high temperature could even mean room temperature.

8. Which among the following relation is true for a reaction to be spontaneous at all temperatures?

- (1) $\Delta H > 0, \Delta S < 0$ (2) $\Delta H < 0, \Delta S < 0$
 (3) $\Delta H < 0, \Delta S > 0$ (4) $\Delta H > 0, \Delta S > 0$

9. For the reaction



$$\Delta H = -95.4 \text{ kJ and } \Delta S = -198.3 \text{ JK}^{-1}$$

The temperature below which reaction will always be non-spontaneous is

- (1) 526 K (2) 500 K
 (3) 495 K (4) 481 K

10. For the reaction $\text{H}_2(\text{g}) \rightarrow 2\text{H}(\text{g})$, the correct option is

- (1) $\Delta H > 0, \Delta S > 0$ (2) $\Delta H < 0, \Delta S > 0$
 (3) $\Delta H < 0, \Delta S < 0$ (4) $\Delta H > 0, \Delta S < 0$



Chapter-6 : Thermodynamics

SECTION-I : NCERT Liners

- | | | |
|-----------------------------|------------------------------|------------------------------|
| 1. (T), [NCERT-XI, Pg. 169] | 8. (T), [NCERT-XI, Pg. 166] | 15. (T), [NCERT-XI, Pg. 168] |
| 2. (T), [NCERT-XI, Pg. 166] | 9. (F), [NCERT-XI, Pg. 174] | 16. (T), [NCERT-XI, Pg. 169] |
| 3. (F), [NCERT-XI, Pg. 169] | 10. (F), [NCERT-XI, Pg. 162] | 17. (T), [NCERT-XI, Pg. 185] |
| 4. (T), [NCERT-XI, Pg. 171] | 11. (T), [NCERT-XI, Pg. 166] | 18. (T), [NCERT-XI, Pg. 186] |
| 5. (T), [NCERT-XI, Pg. 173] | 12. (F), [NCERT-XI, Pg. 167] | 19. (T), [NCERT-XI, Pg. 164] |
| 6. (T), [NCERT-XI, Pg. 183] | 13. (T), [NCERT-XI, Pg. 186] | 20. (F), [NCERT-XI, Pg. 165] |
| 7. (T), [NCERT-XI, Pg. 185] | 14. (F), [NCERT-XI, Pg. 176] | |

SECTION-II : Assertion-Reason type

- | | | |
|--------|--------|---------|
| 1. (1) | 5. (2) | 9. (2) |
| 2. (2) | 6. (1) | 10. (2) |
| 3. (1) | 7. (1) | |
| 4. (1) | 8. (2) | |

SECTION-III : Check Your Understanding

- | | |
|---|---|
| 1. Answer (4)
For $\text{NaCl(s)} \rightarrow \text{Na}^{\text{+}}(\text{g}) + \text{Cl}^{\text{-}}(\text{g})$
$\Delta_{\text{lattice}}H^{\circ} = 411.2 + 108.4 + 121 + 495.6 - 348.6$
$= 787.6 \text{ kJ}$ | 2. Answer (2)
$\Delta_{\text{sol}}H^{\circ} = \Delta_{\text{lattice}}H^{\circ} + \Delta_{\text{hyd}}H^{\circ}$
$= 787.6 - 783.6$
$= + 4 \text{ kJ mol}^{-1}$ |
|---|---|

3. Answer (1)

AB $\rightarrow$ Isobaric expansionBC $\rightarrow$ Isochoric changeCA $\rightarrow$ Isothermal compression

4. Answer (2)

ΔU , ΔH and ΔS are zero for overall reaction as these are state functions but q is non-zero as it is a path function.

5. Answer (3)

Total work done (W) = $W_{A \rightarrow B} + W_{B \rightarrow C} + W_{C \rightarrow A}$ $W_{A \rightarrow B} = -P(V_B - V_A)$ $= -2(20 - 10)$ $= -2(10)$ $= -20 \text{ L atm}$ $W_{B \rightarrow C} = 0$ (Isochoric change)
$$W_{C \rightarrow A} = -2.303 nRT \log \left(\frac{V_A}{V_C} \right) [PV = nRT]$$

$$= -2.303 \times 2 \times 10 \log \left(\frac{10}{20} \right)$$

$$= -2.303 \times 20 \times (-0.3010)$$
 $= +13.86 \text{ L atm}$ Total work done $= -20 + 13.86 = -6.14 \text{ L atm}$

6. Answer (2)

Higher the enthalpy change higher is the intermolecular forces of attractions.

7. Answer (4)

$$\Delta_{\text{fus}} S = \frac{\Delta_{\text{fus}} H^0}{T_f} \quad [T_f \rightarrow \text{melting point of } C_6H_6 \text{ in K}]$$

$$\Delta_{\text{fus}} S(C_6H_6) = \frac{9.83}{278.65} = 0.0352 \text{ kJ mol}^{-1} \text{ K}^{-1}$$

$$= 35.2 \text{ J mol}^{-1} \text{ K}^{-1}$$

8. Answer (3)

For a reaction to be spontaneous at all temperature,

 $\Delta H < 0$ $\Delta S > 0$ $\Delta G < 0$

9. Answer (4)

 $\Delta G = \Delta H - T\Delta S$ For spontaneous reaction, $\Delta G < 0$ $\Rightarrow \Delta H - T\Delta S < 0$ $\Delta H < T\Delta S$

$$\frac{\Delta H}{\Delta S} < T$$
 $481 \text{ K} < T$

Reaction will always be non-spontaneous below 481 K

10. Answer (1)

For $H_2(g) \rightarrow 2H(g)$ $\Delta H > 0$ due to endothermic process $\Delta S > 0$ due to increase in number of particles.

Chapter

Percentage Score

[illegible]

17. In aqueous solution the H^+ ion is further hydrated to gives $H_5O_2^+$, $H_7O_3^+$ and $H_9O_4^+$. ☐
18. The conjugate acid-base pair differ by only one proton. ☐
19. Ionic product of water K_w cannot change with temperature. ☐
20. HF is stronger acid than CH_3COOH . ☐
21. For polyprotic acid the higher order ionization constants (K_{a_2} , K_{a_3}) are smaller than lower order ionization constant (K_{a_1}). ☐
22. In the same group of the periodic table, H-A bond polarity becomes the deciding factor for determining the acid strength. ☐

SECTION-II : Assertion-Reason type

In the following questions, a statement of assertion (A) is followed by a statement of reason (R).

- (1) If both Assertion & Reason are true and the Reason is the correct explanation of the Assertion, then mark (1).
- (2) If both Assertion & Reason are true but the Reason is not the correct explanation of the Assertion, then mark (2).
- (3) If Assertion is true statement but Reason is false, then mark (3).
- (4) If both Assertion & Reason are false statements, then mark (4).

1. A: In reaction, $C(s) + CO_2(g) \rightleftharpoons 2CO(g)$, when pressure is increased, the reaction goes in the reverse direction.

R: The number of gaseous moles decreases in the forward direction.

2. A: HCl, HI, H_2SO_4 , HNO_3 are termed as strong acids.

R: They act as proton (H^+) donors.

3. A: Precipitate formation takes place when $IP > K_{sp}$.

R: $IP = K_{sp}$ is true for saturated solution.

4. A: pH of NH_4OH solution decreases when NH_4Cl is added to it.

R: NH_4Cl provides a common ion NH_4^+ to NH_4OH .

5. A: For the reaction $2HI(g) \rightleftharpoons H_2(g) + I_2(g)$; Change in pressure does not affect the equilibrium state.

R: For the reaction $2HI(g) \rightleftharpoons H_2(g) + I_2(g)$; $\Delta n_g = 0$.

6. A: Whenever an equilibrium is disturbed by a change in concentration, pressure or volume, the composition of the equilibrium mixture changes.

R: When a change in temperature occurs, the value of equilibrium constant, K_c is changed.

7. A: Ionisation of acetic acid is suppressed by adding sodium acetate.

R: Addition of acetate ion to acetic acid solution decreases the dissociation of acetic acid due to common ion effect.

8. A: A catalyst does not alter the concentration of the reactants and products in a state of equilibrium.

R: A catalyst increases the speed of both forward and backward reactions to the same extent.

9. A : The value of equilibrium constant is independent of initial concentrations of the reactants and products.

R : Equilibrium constant is applicable only when concentration of the reactants and products have attained their equilibrium state.



For above reaction,

$$K_c = \frac{[\text{Ni(CO)}_4]}{[\text{CO}]^4}$$

R : For heterogeneous equilibrium, the concentrations of pure solids or liquids are not considered in the expression of equilibrium constant.

11. A : A chemical equilibrium remains undisturbed when an inert gas is added to the system at constant volume.

R : The addition of an inert gas at constant volume does not change the partial pressure or the molar concentration of the substances involved in the reaction.

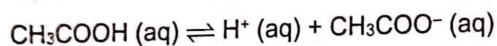
12. A : AlCl_3 is a Lewis acid.

R : AlCl_3 can accept electron pair.

SECTION-III : Check Your Understanding

PROBLEM 1:

Consider an example of acetic acid dissociation equilibrium represented as:



$$K_a = \frac{[\text{H}^+][\text{CH}_3\text{COO}^-]}{[\text{CH}_3\text{COOH}]}$$

Addition of acetate ions to an acetic acid solution results in decreasing the concentration of hydrogen ions, $[\text{H}^+]$. Also if H^+ ions are added from an external source then the equilibrium moves in the direction of undissociated acetic acid i.e., in a direction of reducing the concentration of hydrogen ions, $[\text{H}^+]$. This phenomenon is an example of common ion effect.

- In which among the following mixtures common ion effect can be observed?
 - $\text{CH}_3\text{COOH} + \text{NaOH}$
 - $\text{NH}_4\text{OH} + \text{HCl}$
 - $\text{NaHCO}_3 + \text{H}_2\text{CO}_3$
 - $\text{HCl} + \text{NaCl}$
- Ionisation constant of 0.1 M CH_3COOH is 1.7×10^{-5} . The pH of 0.1 M CH_3COOH is
 - 2.88
 - 4.82
 - 1.18
 - 3.18

- The degree of dissociation of 0.1 M CH_3COOH solution if equal volume of 0.1 M HCl is added into the solution ($\text{p}K_a(\text{CH}_3\text{COOH}) = 1.74 \times 10^{-5}$)
 - 8.8×10^{-6}
 - 3.48×10^{-5}
 - 3.48×10^{-4}
 - 3.48×10^{-6}

PROBLEM 2:

Salts formed by the reactions between acids and bases in definite proportions undergo ionization in water. The cations/anions formed on ionization of salts either exist as hydrated ions in aqueous solution or interact with water to reform corresponding acids/bases depending upon the nature of salts. The process of interaction between water and cations/anions or both of salts is called hydrolysis.

- Aqueous solution of which of the following salt will have the highest pH?
 - KCl
 - KHCO_3
 - K_2CO_3
 - NH_4Br
- The pH of a solution containing equimolar mixture of NH_4OH and CH_3COOH at 27°C will be [$\text{p}K_a(\text{CH}_3\text{COOH}) = 4.76$, $\text{p}K_b(\text{NH}_4\text{OH}) = 4.75$]
 - 6.005
 - 7.005
 - 8.005
 - 9.005

6. In which among the following salts only cation undergoes hydrolysis.

- (1) KCl
- (2) CH_3COONa
- (3) NaCl
- (4) NH_4Cl

- (1) 10
- (2) 10^{-1}
- (3) 100
- (4) 10^{-2}

PROBLEM 3:

To prepare acidic/basic buffer we use weak acid/base and its salt formed with strong acid/base. We develop the equation relating the pH, the equilibrium constant, K_a of weak acid/ K_b of weak base and ratio of concentration of weak acid/weak base and its conjugate base/acid.

- For acidic buffer solution

$$\text{pH} = \text{p}K_a + \log \frac{[\text{Conjugate acid, } A^-]}{[\text{Acid, HA}]}$$

- For basic buffer solution

$$\text{pOH} = \text{p}K_b + \log \frac{[\text{Conjugate base, } BH^+]}{[\text{Base, B}]}$$

This expression is known as Henderson – Hasselbalch equation.

7. Which of the following will make acidic buffer?

- (1) 50 ml of 0.1 M CH_3COOH + 50 ml of 0.1 M NaOH
- (2) 50 ml of 0.1 M HCl + 100 ml of 0.1 M NaOH
- (3) 100 ml of 0.1 M CH_3COONa + 50 ml of 0.1 M HCl
- (4) 50 ml of 0.1 M NaOH + 25 ml of 0.1 M CH_3COOH

8. Solution of 0.1 N NH_4OH and 0.01 N NH_4Cl has pH 10.25. Then the $\text{p}K_b$ of NH_4OH is

- (1) 5.75
- (2) 3.75
- (3) 4.75
- (4) 6.75

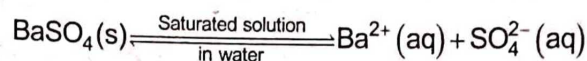
9. The dissociation constant of a weak acid is 10^{-5} . In order to prepare a buffer solution with a pH = 4.

The $\frac{\text{Salt}}{\text{Acid}}$ ratio should be

PROBLEM 4:

The solubility depends on a number of factors important amongst which are the lattice enthalpy of the salt and the solvation enthalpy of the ions in a solution.

Let us take an example.



$$K_{sp} = (s)^2$$

Where, K_{sp} is the solubility product constant and s is molar solubility of the barium sulphate.

The common ion effect can also affect the solubility of a sparingly soluble salt.

10. The solubility product of BaF_2 in water is 1.0×10^{-6} at 298 K. The molar solubility of BaF_2 is

- (1) $\frac{10^{-2}}{4}$
- (2) $\frac{10^{-2}}{(4)^{\frac{1}{2}}}$
- (3) $\frac{10^{-2}}{(4)^{\frac{1}{3}}}$
- (4) $10^{-2} \times (4)^{1/3}$

11. The correct order of solubility for the given salts CuCl ($K_{sp} = 1.7 \times 10^{-6}$), PbCO_3 ($K_{sp} = 7.4 \times 10^{-14}$) and SnS ($K_{sp} = 1.0 \times 10^{-25}$) is

- (1) $\text{CuCl} > \text{SnS} > \text{PbCO}_3$
- (2) $\text{CuCl} > \text{PbCO}_3 > \text{SnS}$
- (3) $\text{PbCO}_3 > \text{SnS} > \text{CuCl}$
- (4) $\text{SnS} > \text{PbCO}_3 > \text{CuCl}$

12. The solubility of AgCl is minimum in

- (1) H_2O
- (2) 0.1 M NaCl
- (3) $\text{NH}_3(aq.)$
- (4) $\text{NaI}(aq.)$

Chapter-7 : Equilibrium

SECTION-I : NCERT Liners

- | | | |
|------------------------------|-------------------------------|-------------------------------|
| 1. (T), [NCERT-XII, Pg. 185] | 9. (F), [NCERT-XII, Pg. 193] | 17. (T), [NCERT-XII, Pg. 207] |
| 2. (F), [NCERT-XII, Pg. 185] | 10. (T), [NCERT-XII, Pg. 197] | 18. (T), [NCERT-XII, Pg. 208] |
| 3. (F), [NCERT-XII, Pg. 186] | 11. (F), [NCERT-XII, Pg. 202] | 19. (F), [NCERT-XII, Pg. 211] |
| 4. (T), [NCERT-XII, Pg. 186] | 12. (F), [NCERT-XII, Pg. 198] | 20. (T), [NCERT-XII, Pg. 212] |
| 5. (T), [NCERT-XII, Pg. 187] | 13. (F), [NCERT-XII, Pg. 199] | 21. (T), [NCERT-XII, Pg. 217] |
| 6. (F), [NCERT-XII, Pg. 187] | 14. (T), [NCERT-XII, Pg. 204] | 22. (F), [NCERT-XII, Pg. 217] |
| 7. (T), [NCERT-XII, Pg. 188] | 15. (T), [NCERT-XII, Pg. 206] | |
| 8. (T), [NCERT-XII, Pg. 189] | 16. (T), [NCERT-XII, Pg. 206] | |

Corporate Office : Aakash Tower, 8, Pusa Road, New Delhi-110005. Phone : 011-47623456

SECTION-II : Assertion-Reason type

- | | | |
|--------|--------|---------|
| 1. (3) | 5. (1) | 9. (2) |
| 2. (2) | 6. (2) | 10. (1) |
| 3. (1) | 7. (1) | 11. (1) |
| 4. (1) | 8. (1) | 12. (1) |

SECTION-III : Check Your Understanding

1. Answer (3)



Due to common ion HCO_3^- . In mixture of $\text{NaHCO}_3 + \text{H}_2\text{CO}_3$ common ion effect is observed.

2. Answer (1)

$$\text{pH} = \frac{1}{2}[\text{pK}_a - \log c]$$

$$= \frac{1}{2}[4.76 - \log 10^{-1}] = 2.88$$

3. Answer (3)

In presence of common ion effect, degree of dissociation (α) = $\frac{K_a}{[\text{Common ion}]}$

$$\alpha = \frac{1.74 \times 10^{-5}}{0.05}$$

$$\alpha = 3.48 \times 10^{-4}$$

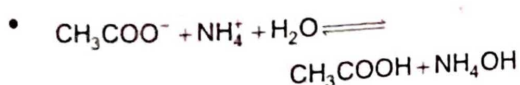
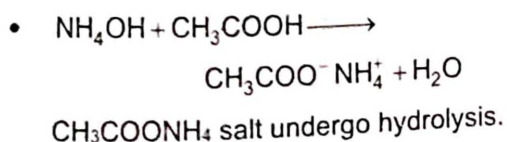
4. Answer (3)

The anions of weak acids undergo hydrolysis.



Due to this K_2CO_3 will have highest pH.

5. Answer (2)



$$\text{pH} = 7 + \frac{1}{2}(\text{pK}_a - \text{pK}_b)$$

$$= 7 + \frac{1}{2}[4.76 - 4.75]$$

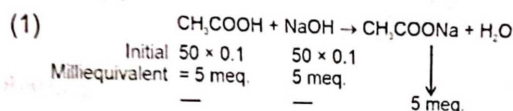
$$\text{pH} = 7.005$$

6. Answer (4)

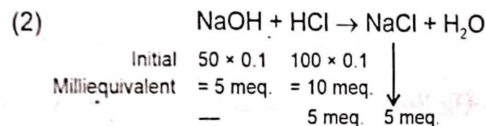
The cation of weak base undergo hydrolysis. Hence, NH_4^+ of NH_4Cl can react with water



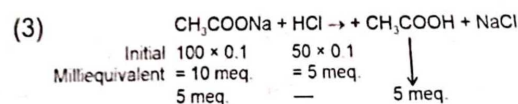
7. Answer (3)



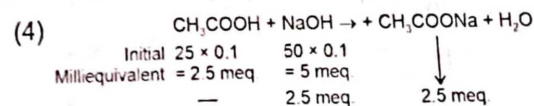
- Not a buffer solution.



- Not a buffer solution.



- Mixture of $(\text{CH}_3\text{COONa} + \text{CH}_3\text{COOH})$ is a acidic buffer.



- Not a buffer solution.

8. Answer (3)

Mixture of $\text{NH}_4\text{OH} + \text{NH}_4\text{Cl}$ act as basic buffer.

$$\text{pOH} = \text{pK}_b + \log \frac{[\text{Salt}]}{[\text{Base}]}$$

$$\text{pOH} = 14 - 10.25$$

$$= 3.75$$

$$3.75 = \text{p}K_b + \log \frac{[0.01]}{[0.1]}$$

$$3.75 = \text{p}K_b + \log [0.1]$$

$$\text{p}K_b = 3.75 - \log [0.1]$$

$$\text{p}K_b = 4.75$$

9. Answer (2)

For an acidic Buffer,

$$\text{pH} = \text{p}K_a + \log \frac{[\text{Salt}]}{[\text{Acid}]}$$

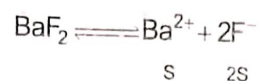
$$4 = -\log [10^{-5}] + \log \frac{[\text{Salt}]}{[\text{Acid}]}$$

$$4 = 5 + \log \frac{[\text{Salt}]}{[\text{Acid}]}$$

$$\log \frac{[\text{Salt}]}{[\text{Acid}]} = -1$$

$$\frac{[\text{Salt}]}{[\text{Acid}]} = 10^{-1}$$

10. Answer (3)



$$K_{\text{sp}} = (\text{S})(2\text{S})^2$$

$$K_{\text{sp}} = 4\text{S}^3$$

$$\text{S} = \left(\frac{K_{\text{sp}}}{4} \right)^{\frac{1}{3}} = \left(\frac{1.0 \times 10^{-6}}{4} \right)^{\frac{1}{3}}$$

$$\text{S} = \frac{10^{-2}}{(4)^{\frac{1}{3}}}$$

11. Answer (2)

For same type of salts, as K_{sp} increase, solubility of salt also increases.

- K_{sp} order is, $\text{CuCl} > \text{PbCO}_3 > \text{SnS}$
- Solubility order will be, $\text{CuCl} > \text{PbCO}_3 > \text{SnS}$

12. Answer (2)

In presence of NaCl , Cl^- show common ion effect with AgCl . Hence solubility of AgCl will decrease.

Redox Reactions

8

Chapter

Marking Scheme

1. For every correct answer you earn four marks (+4).
2. For every incorrect answer you lose one mark (-1).

Marks Obtained

Maximum Marks

188

Percentage Score

SECTION-I : NCERT Liners

Choose whether the statement is True (T) or False (F).

- | | T | F |
|--|--------------------------|--------------------------|
| 1. Oxidation is the addition of oxygen / electronegative element to a substance or removal of hydrogen / electropositive element from a substance. | ☐ | ☐ |
| 2. On placing Zn strip in aqueous solution of $\text{Cu}(\text{NO}_3)_2$, blue colour of solution disappears. | ☐ | ☐ |
| 3. $2\text{Na}(\text{s}) + \text{H}_2(\text{g}) \rightarrow 2\text{NaH}(\text{g})$ is a redox reaction. | ☐ | ☐ |
| 4. Loss of electron(s) by any species is called reduction. | ☐ | ☐ |
| 5. Reducing agent is donor of electron(s). | ☐ | ☐ |
| 6. The electron releasing tendency of the metals is in the order : $\text{Zn} > \text{Cu} > \text{Ag}$. | ☐ | ☐ |
| 7. In S_8 , sulphur atom bears an oxidation number of zero. | ☐ | ☐ |
| 8. In all its compounds, fluorine has an oxidation number of -1. | ☐ | ☐ |
| 9. An oxidising agent increases the oxidation number of an element in a given substance. | ☐ | ☐ |
| 10. In Na_2O_2 , oxidation state of oxygen is -2. | ☐ | ☐ |
| 11. Conversion of $\text{Mn}(\text{II}) \text{O}$ to $\text{Mn}(\text{IV}) \text{O}_2$ is oxidation of manganese. | ☐ | ☐ |
| 12. $3\text{Mg}(\text{s}) + \text{N}_2(\text{g}) \xrightarrow{\Delta} \text{Mg}_3\text{N}_2(\text{s})$ is a type of combination reaction. | ☐ | ☐ |
| 13. $2\text{KClO}_3(\text{s}) \xrightarrow{\Delta} 2\text{KCl}(\text{s}) + 3\text{O}_2(\text{g})$ is a type of displacement reaction. | ☐ | ☐ |
| 14. All alkali metals and some alkaline earth metals (Ca, Sr and Ba) which are very good reductants, will displace hydrogen from cold water. | ☐ | ☐ |
| 15. Fluorine is the strongest oxidising agent among all the halogens. | ☐ | ☐ |
| 16. In Br_3O_8 , central Bromine atom is in +4 oxidation state. | ☐ | ☐ |

17. In $S_4O_6^{2-}$ ion, each of the two extreme sulphurs exhibits oxidation state of +5 and the middle sulphurs as zero.
18. MnO_4^- acts as a self indicator.
19. The standard electrode potential (E°) of hydrogen electrode is 0.00 volts.
20. A negative E° means that the redox couple is a stronger oxidising agent than the $H^+ | H_2$ couple.
21. Highest oxidation state of 16th group element is +6.
22. ClO_3^- does not show disproportionation.

SECTION-II : Assertion-Reason type

In the following questions, a statement of assertion (A) is followed by a statement of reason (R).

- (1) If both Assertion & Reason are true and the Reason is the correct explanation of the Assertion, then mark (1).
- (2) If both Assertion & Reason are true but the Reason is not the correct explanation of the Assertion, then mark (2).
- (3) If Assertion is true statement but Reason is false, then mark (3).
- (4) If both Assertion & Reason are false statements, then mark (4).

1. A : The term oxidation was used to describe the addition of oxygen to an element or a compound.
R : In superoxides, oxidation number of oxygen is +2.
2. A : Fluorine acts as a stronger oxidising agent than oxygen.
R : Fluorine is more electronegative than oxygen.
3. A : $NaOH + HCl \rightarrow NaCl + H_2O$ is a redox reaction.
R : Na is undergoing oxidation in above reaction.
4. A : The half reactions that involve loss of electrons are called oxidation reactions.
R : The half reactions that involve gain of electrons are called reduction reactions.
5. A : The atoms of transition elements usually display several positive oxidation states.
R : The highest oxidation number exhibited by an atom of an element generally decreases across the period in the periodic table.
6. A : In polyatomic ions, the algebraic sum of all the oxidation numbers of atoms of ions is equal to the charge on ion.
R : In ions, composed of only one atom, the oxidation number is equal to the charge on the ion.
7. A : The sum of oxidation number of three oxygen atoms and one carbon atom in the carbonate ion $[CO_3]^{2-}$ is equal to -2.
R : The algebraic sum of the oxidation number of all the atoms in a compound must be zero.
8. A : In the following chemical reaction between $H_2S(g)$ and $Cl_2(g)$, $H_2S(g)$ is oxidized to $S(s)$.
$$H_2S(g) + Cl_2(g) \longrightarrow 2HCl(g) + S(s)$$

R : Electropositive element, hydrogen has been removed from S.
9. A : Br^- and I^- can be identified by 'Layer test'.
R : Br_2 and I_2 are coloured and dissolve in CCl_4 can easily be identified from the colour of solution.

34 Redox Reactions

10. A: Fluorine is the best oxidant among hydrohalic compounds.
R: Hydroiodic acid is the best reductant.
11. A: In acidic medium, potassium dichromate act as a powerful oxidising agent.
R: $K_2Cr_2O_7$ reduces to give Cr^{2+} in acidic medium.
12. A: $P_4 + OH^- \rightarrow PH_3 + HPO_2^-$ is a disproportionation reaction.
R: In above reaction, P_4 is undergoing reduction as well as oxidation.
13. A: Chlorine is used to purify drinking water.
R: Excess of chlorine is removed by treating with sulphur dioxide.
14. A: Oxidation state of hydrogen in CaH_2 is -1 .
R: CaH_2 is a metal hydride and for hydrides, hydrogen is assigned the oxidation number of -1 .
15. A: In the reaction, $Zn(s) + Cu^{+2}(aq) \rightarrow Zn^{+2}(aq) + Cu(s)$, Cu^{+2} ions act as oxidising agent and Zn atoms act as a reducing agent.
R: A substance which readily gain electrons from other substances is an oxidising agent while reducing agent is a substance which can lose electrons to other substances.

SECTION-III : Check Your Understanding

PROBLEM 1:

Two methods are used to balance chemical equations for redox processes. One of these methods is based on the change in the oxidation number of reducing agent and the oxidising agent and the other method is based on splitting the redox reaction into two half reactions - one involving oxidation and the other involving reduction. These both methods are in use and the choice of their use rests with the individual using them.

1. In the chemical reaction,
 $xMnO_4^- (aq) + Br^- (aq) + H_2O(l) \rightarrow yMnO_2(s) + BrO_3^- (aq) + zOH^- (aq)$
 x, y and z respectively are
 (1) 2, 2, 1 (2) 1, 1, 2
 (3) 2, 2, 2 (4) 1, 1, 4
2. How many moles of sodium sulphite oxidised by two moles of potassium dichromate in acidic medium?
 (1) 2 (2) 3
 (3) 4 (4) 6
3. In acidic and alkaline medium permanganate ion reduces to
 (1) Mn^{2+} and Mn^{2+} respectively
 (2) Mn^{2+} and MnO_2 respectively
 (3) MnO_2 and MnO_2 respectively
 (4) MnO_2 and Mn^{2+} respectively

PROBLEM 2:

Disproportionation reactions are a special type of redox reactions. In a disproportionation reaction an element in one oxidation state is simultaneously oxidised and reduced. One of the reacting substances in a disproportionation reaction always contains an element that can exist in at least three oxidation states; and both higher and lower oxidation states of that element are formed in the reaction. The decomposition of hydrogen peroxide is a familiar example of the reaction, where oxygen experiences disproportionation.

4. The product(s) formed when white phosphorous undergo disproportionation in the alkaline medium is/are
 (1) PH_3 and $H_2PO_2^-$
 (2) PH_3 only
 (3) H_3PO_3 and $H_2PO_4^-$
 (4) $H_2PO_4^-$ only
5. Which among the following species do not show disproportionation reaction?
 (1) ClO^-
 (2) ClO_2^-
 (3) ClO_3^-
 (4) ClO_4^-

6. Which of the following reaction is an example of disproportionation reaction?

- (1) $2\text{PbNO}_3(\text{s}) \rightarrow 2\text{PbO}(\text{s}) + 4\text{NO}_2(\text{g}) + \text{O}_2(\text{g})$
- (2) $\text{NaH}(\text{s}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{NaOH}(\text{aq}) + \text{H}_2(\text{g})$
- (3) $\text{Cl}_2(\text{g}) + 2\text{NaOH}(\text{aq}) \rightarrow \text{NaClO}(\text{aq}) + \text{NaCl}(\text{aq}) + \text{H}_2\text{O}(\text{l})$
- (4) $\text{CH}_4(\text{g}) + 4\text{Cl}_2(\text{g}) \rightarrow \text{CCl}_4(\text{l}) + 4\text{HCl}(\text{g})$

7. Which halogen does not show a disproportionation tendency?

- (1) Br_2
- (2) I_2
- (3) F_2
- (4) Cl_2

PROBLEM 3:

The electron shift in chemical reactions involving formation of covalent compounds, a more practical method of using Oxidation number has been developed. In this method, it is always assumed that there is a complete transfer of electron from a less electronegative atom to a more electronegative atom. Oxidation number denotes the oxidation state of an element in a compound ascertained according to a set of rules formulated on the basis that electron pair in a covalent bond belong entirely to more electronegative element. It is not always possible to remember or make out easily in a compound/ion,

which element is more electronegative than other. Therefore, a set of rules has been formulated to determine the oxidation number of an element in a compound/ion.

8. Group-15 element can show highest oxidation state

- (1) +3
- (2) +7
- (3) +5
- (4) +4

9. The correct oxidation state of oxygen in O_2F_2 and OF_2 respectively are

- (1) +1 and +2 respectively
- (2) -1 and +2 respectively
- (3) +2 and -2 respectively
- (4) -1 and -2 respectively

10. What is the oxidation state of central 'carbon' atom in carbon suboxide?

- (1) $+\frac{4}{3}$
- (2) Zero
- (3) +2
- (4) $+\frac{2}{3}$



Chapter-8 : Redox Reactions

SECTION-I : NCERT Liners

- | | | |
|------------------------------|-------------------------------|-------------------------------|
| 1. (T), [NCERT- XI, Pg. 264] | 9. (T), [NCERT- XI, Pg. 269] | 17. (T), [NCERT- XI, Pg. 273] |
| 2. (T), [NCERT- XI, Pg. 266] | 10. (F), [NCERT- XI, Pg. 268] | 18. (T), [NCERT- XI, Pg. 277] |
| 3. (T), [NCERT- XI, Pg. 264] | 11. (T), [NCERT- XI, Pg. 269] | 19. (T), [NCERT- XI, Pg. 278] |
| 4. (F), [NCERT- XI, Pg. 265] | 12. (T), [NCERT- XI, Pg. 270] | 20. (F), [NCERT- XI, Pg. 279] |
| 5. (T), [NCERT- XI, Pg. 265] | 13. (F), [NCERT- XI, Pg. 270] | 21. (T), [NCERT- XI, Pg. 269] |
| 6. (T), [NCERT- XI, Pg. 267] | 14. (T), [NCERT- XI, Pg. 271] | 22. (F), [NCERT- XI, Pg. 272] |
| 7. (T), [NCERT- XI, Pg. 268] | 15. (T), [NCERT- XI, Pg. 271] | |
| 8. (T), [NCERT- XI, Pg. 268] | 16. (T), [NCERT- XI, Pg. 273] | |

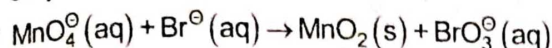
SECTION-II : Assertion-Reason type

- | | | |
|--------|---------|---------|
| 1. (3) | 6. (2) | 11. (3) |
| 2. (2) | 7. (2) | 12. (1) |
| 3. (4) | 8. (1) | 13. (2) |
| 4. (2) | 9. (1) | 14. (1) |
| 5. (3) | 10. (2) | 15. (1) |

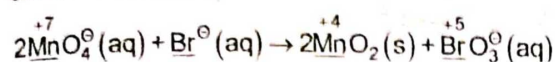
SECTION-III : Check Your Understanding

1. Answer (3)

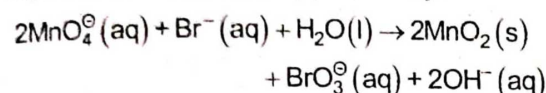
Step 1: The ionic equation is



Step 2: Assign oxidation number of Mn and Br and make the increase equal to decrease in oxidation number.

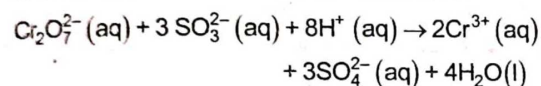


Step 3: As the reaction occurs in basic medium, add OH^- ions and H_2O appropriately.



2. Answer (4)

The correct balanced redox reaction is



1 mole of $\text{Cr}_2\text{O}_7^{2-}(\text{aq})$ requires 3 moles of $\text{SO}_3^{2-}(\text{aq})$.

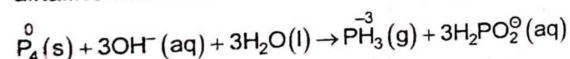
So, 2 moles of $\text{Cr}_2\text{O}_7^{2-}(\text{aq})$ requires 6 moles of $\text{SO}_3^{2-}(\text{aq})$.

3. Answer (2)

In acidic medium, MnO_4^- ion reduces to Mn^{2+} ion and in basic medium, MnO_4^- ion reduces to MnO_2 .

4. Answer (1)

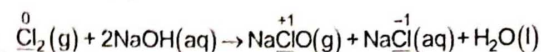
Phosphorous undergo disproportionation in the alkaline medium:



5. Answer (4)

ClO_4^- does not disproportionate because in this oxoanion, chlorine is present in its highest oxidation state that is, +7.

6. Answer (3)



Here the chlorine of Cl_2 , which is present in zero oxidation state, is converted to +1 oxidation state in NaClO and decreases to -1 oxidation state in NaCl . So, chlorine undergoing disproportionation with NaOH .

7. Answer (3)

Being the most electronegative element, fluorine cannot exhibit any positive oxidation state.

So, fluorine cannot show a disproportionation tendency.

8. Answer (3)

Group-15 element can show highest oxidation state +5.

eg: In P_4O_{10} , oxidation state of phosphorous is +5.

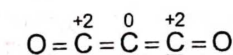
9. Answer (1)

The correct oxidation state of oxygen in O_2F_2 and OF_2 respectively are +1 and +2.

In O_2F_2 and OF_2 , fluorine is in -1 oxidation state.

10. Answer (2)

The correct structure of C_3O_2 is



The central 'carbon' atom is in zero oxidation state.

1. For every correct answer you earn four marks (+4).
2. For every incorrect answer you lose one mark (-1).

$$\frac{\text{Marks Obtained}}{\text{Maximum Marks}} = \frac{232}{250}$$

Percentage Score

SECTION-I : NCERT Liners

T	F
---	---

1. Tritium is radioactive and emits low energy β^- particles
2. High purity ($> 99.95\%$) dihydrogen is obtained by electrolysis of warm aqueous $\text{Ba}(\text{OH})_2$ solution between Ni electrodes.
3. The H-H bond dissociation enthalpy is the lowest for a single bond between two atoms of any element.
4. Hydroformylation of olefins yields carboxylic acids.
5. Atomic hydrogen and oxy-hydrogen torches find use for cutting and welding purposes.
6. Dihydrogen is used in fuel cells for generating electrical energy.
7. Significant covalent character is found in the lighter metal hydrides such as LiH .
8. Saline hydrides react violently with water producing dihydrogen gas.
9. Metals of group 5, 6 and 7 do not form hydrides .
10. Density of ice is more than that of water.
11. Three hydrogen-bonded water molecule(s) are associated in $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$.
12. During boiling hard water containing $\text{Mg}(\text{HCO}_3)_2$ is converted into insoluble MgCO_3 .
13. In Clark's method for removing temporary hardness, excess of lime is used.
14. Permanent hardness of water is due to the presence of soluble salts of Mg and Ca in the form of chloride and sulphate in water.
15. Calgon is the commercial name of sodium hexametaphosphate.
16. In ion-exchange method when zeolite is exhausted it is regenerated by treating with aq. NaOH solution.
17. Industrially H_2O_2 is prepared by the auto-oxidation of 2-ethylphenol.

18. A 20% solution of H_2O_2 is marketed as '100 volume' H_2O_2 . ☐
19. As an antiseptic, H_2O_2 is sold in the market as perhydrol. ☐
20. Heavy water is used as a moderator in nuclear reactors. ☐
21. Dihydrogen on the industrial scale is prepared by the water-gas shift reaction from petrochemicals. ☐
22. The basic principle of hydrogen economy is the transportation and storage of energy in the form of liquid or gaseous dihydrogen. ☐
23. Pd can be used as storage media for hydrogen. ☐
24. Diborane is an example of electron-precise hydride. ☐
25. At atmospheric pressure ice crystallises in the Hexagonal form. ☐
26. Isotopes of hydrogen have same number of neutrons. ☐
27. Hydrogen does not possess metallic properties under normal conditions. ☐
28. Cation exchange resins contain large organic molecule with $-\text{NH}_2$ group. ☐
29. H^+ does not exist freely. ☐
30. Water behaves as an amphoteric substance. ☐
31. H_2O_2 has planar structure. ☐

SECTION-II : Assertion-Reason type

In the following questions, a statement of assertion (A) is followed by a statement of reason (R).

- (1) If both Assertion & Reason are true and the Reason is the correct explanation of the Assertion, then mark (1).
- (2) If both Assertion & Reason are true but the Reason is not the correct explanation of the Assertion, then mark (2).
- (3) If Assertion is true statement but Reason is false, then mark (3).
- (4) If both Assertion & Reason are false statements, then mark (4).

1. A : Due to higher electronegativity of N, O and F, the magnitude of hydrogen bonding in their hydrides will be quite appreciable.
R : The boiling points of NH_3 , H_2O and HF are higher than the hydrides of their subsequent group members.
2. A : The atomic hydrogen is produced at a high temperature.
R : Dihydrogen is relatively inert at room temperature due to high H-H bond enthalpy.
3. A : H_2O_2 acts as an oxidizing agent as well as reducing agent.
R : In H_2O_2 , oxygen has -1 oxidation state and it can increase or decrease its oxidation state.
4. A : Hydrogen isotopes have different rate of chemical reaction.
R : Protium, deuterium and tritium have different bond dissociation enthalpy.
5. A : The usual properties of water in the condensed phase (liquid and solid states) are abnormal as compare to other.
R : There is presence of extensive hydrogen bonding between water molecules.

6. A : The water molecule is polar in nature.
R : Water molecule contain two polar bonds and have bent shape.
7. A : The basic principle of hydrogen economy is the transportation and storage of energy in the form of liquid or gaseous dihydrogen.
R : On a mass for mass basis dihydrogen can release about three times more energy than petrol.
8. A : An ice cube floats over water.
R : Density of ice is less than that of water.
9. A : Hard water is harmful for boilers.
R : Hard water causes scaling in boiler due to deposition of salts.
10. A : Hard water is unsuitable for laundry.
R : Hard water produces lather with soap containing sodium stearate ($C_{17}H_{35}COONa$).
11. A : "10 Volume" solution of H_2O_2 means that 1 L of this H_2O_2 solution will give 10 L of oxygen at STP.
R : Strength of 10 volume H_2O_2 solution is equal to 50 g/L.
12. A : Temporary hardness is due to the presence of bicarbonates of calcium and magnesium.
R : Temporary hardness can be removed by boiling.
13. A : H_2O_2 is a good bleaching agent for delicate materials.
R : In gas phase, dihedral angle of H_2O_2 is 111.5° .
14. A : Mixture of CO & H_2 is known as water gas.
R : Water gas is used in synthesis of methanol.
15. A : Pure zinc is not used in the preparation of dihydrogen by the action of sulphuric acid.
R : Pure zinc reacts very slowly with sulphuric acid.
16. A : Boiling point of H_2O_2 is greater than H_2O .
R : H_2O_2 has extensive hydrogen bonding and higher molar mass than H_2O .
17. A : Ionic hydrides are the ready-made source of H_2 .
R : LiH is an ionic hydride.

SECTION-III : Check Your Understanding

PROBLEM 1:

Dihydrogen, under certain reaction conditions, combines with almost all elements, except noble gases, to form binary compounds, called hydrides. If 'E' is the symbol of an element then hydride can be expressed as EH_x (e.g. MgH_2) or E_mH_n (e.g. B_2H_6). The hydrides can be classified into three categories: (1) Ionic hydrides (2) Covalent hydrides (3) Metallic hydrides.

On the basis of above paragraph, choose the correct option for the following questions.

- Which element forms hydride from group-6?
 - Cr
 - Mo
 - W
 - Sg
- Electron-rich covalent hydrides can be formed by which of the following group elements?
 - Group-14
 - Group-18
 - Group-15
 - Group-2

- Hydride of which of the following element is polymeric in nature?

- | | |
|--------|--------|
| (1) Na | (2) Mg |
| (3) Zr | (4) P |

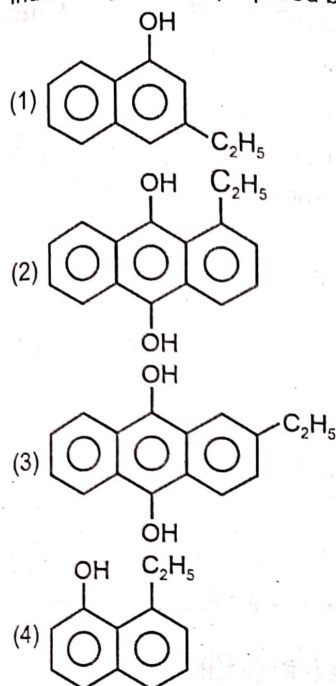
PROBLEM 2:

Hydrogen peroxide is an important chemical used in pollution control treatment of domestic and industrial effluents. Industrially it is prepared by the auto-oxidation of 2-alkyl anthraquinol. It is miscible with water in all proportions. Its commercially marketed sample is 10 V, which means that the sample contains 3% H_2O_2 .

On the basis of above paragraph, choose the correct option for the following questions.

- A 30% solution of H_2O_2 is marketed as '100 volume' hydrogen peroxide. It means that one mL of 30% H_2O_2 solution will give
 - 30 mL of oxygen at STP
 - 100 mL of oxygen at STP
 - 70 mL of oxygen at STP
 - 60 mL of oxygen at STP

5. The strength of 10 volume solution of H_2O_2 is
 (1) 2% (2) 5%
 (3) 8% (4) 3%
6. Industrially H_2O_2 is prepared by the oxidation of



PROBLEM 3:

Presence of Ca and Mg salts in the form of hydrogencarbonate, chloride and sulphate in water makes water hard. Hard water does not give lather with soap. Hard water forms scum with soap. Hardness of water is of two types:

- (i) Temporary hardness (can be removed by boiling or by Clark's method)
 (ii) Permanent hardness (can be removed by treating with washing soda, by Calgon's method, by ion-exchange method or by synthetic resins method)

On the basis of above paragraph, choose the correct option for the following questions.

7. Temporary hardness of water is due to the presence of
 (1) $MgSO_4$ (2) $CaCl_2$
 (3) $MgCl_2$ (4) $Ca(HCO_3)_2$
8. Zeolite is
 (1) Na_2AlSiO_3 (2) $NaAlSiO_2$
 (3) Na_3AlSiO_4 (4) $NaAlSiO_4$
9. Pure de-mineralised (de-ionized) water free from all soluble mineral salts is obtained in
 (1) Clark's method
 (2) Ion-exchange method
 (3) Synthetic resins method
 (4) Calgon's method
10. In synthetic resins method, the exhausted cation exchange resin bed can be regenerated by treatment with
 (1) Dilute HCl
 (2) Dilute NaOH
 (3) Aq. NaCl
 (4) Aq. $Ca(OH)_2$

□ □ □

Chapter-9 : Hydrogen

SECTION-I : NCERT Liners

- | | | |
|-----------------------------|------------------------------|------------------------------|
| 1. (T), [NCERT-XI, Pg. 285] | 6. (T), [NCERT-XI, Pg. 288] | 11. (F), [NCERT-XI, Pg. 291] |
| 2. (T), [NCERT-XI, Pg. 286] | 7. (T), [NCERT-XI, Pg. 288] | 12. (F), [NCERT-XI, Pg. 292] |
| 3. (F), [NCERT-XI, Pg. 286] | 8. (T), [NCERT-XI, Pg. 288] | 13. (F), [NCERT-XI, Pg. 292] |
| 4. (F), [NCERT-XI, Pg. 287] | 9. (F), [NCERT-XI, Pg. 289] | 14. (T), [NCERT-XI, Pg. 292] |
| 5. (T), [NCERT-XI, Pg. 288] | 10. (F), [NCERT-XI, Pg. 290] | 15. (T), [NCERT-XI, Pg. 292] |

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- | | | |
|------------------------------|------------------------------|------------------------------|
| 16. (F), [NCERT-XI, Pg. 292] | 21. (T), [NCERT-XI, Pg. 295] | 27. (T), [NCERT-XI, Pg. 285] |
| 17. (F), [NCERT-XI, Pg. 293] | 22. (T), [NCERT-XI, Pg. 295] | 28. (F), [NCERT-XI, Pg. 292] |
| 18. (F), [NCERT-XI, Pg. 293] | 23. (T), [NCERT-XI, Pg. 289] | 29. (T), [NCERT-XI, Pg. 285] |
| 19. (T), [NCERT-XI, Pg. 294] | 24. (F), [NCERT-XI, Pg. 288] | 30. (F), [NCERT-XI, Pg. 290] |
| 20. (T), [NCERT-XI, Pg. 294] | 25. (T), [NCERT-XI, Pg. 290] | 31. (F), [NCERT-XI, Pg. 294] |
| | 26. (F), [NCERT-XI, Pg. 285] | |

SECTION-II : Assertion-Reason type

- | | | |
|--------|---------|---------|
| 1. (3) | 7. (2) | 13. (2) |
| 2. (1) | 8. (1) | 14. (2) |
| 3. (1) | 9. (1) | 15. (1) |
| 4. (1) | 10. (3) | 16. (1) |
| 5. (1) | 11. (3) | 17. (2) |
| 6. (1) | 12. (2) | |

SECTION-III : Check Your Understanding

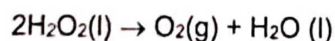
1. Answer (1)
Among group-6 elements, only Cr form hydride.

2. Answer (3)
Group-15 Hydride $\ddot{\text{E}}\text{H}_3$ contain one lone pair on central atom so termed as electron-rich covalent hydrides.

3. Answer (2)
 MgH_2 and BeH_2 are polymeric in nature.

4. Answer (2)
A 30% solution of H_2O_2 means that one millilitre of solution will give 100 mL of oxygen at STP.

5. Answer (4)
10 Volume solution of H_2O_2 means that 1 L of this H_2O_2 solution will give 10 L of oxygen at STP



$$2 \times 34 \text{ g } 22.7 \text{ L at STP}$$

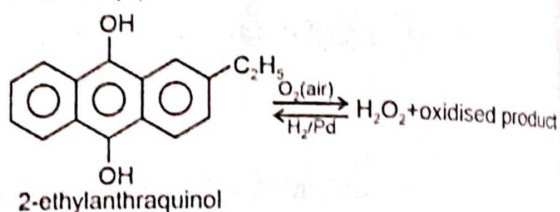
$$68 \text{ g}$$

On the basis of above equation 22.7 L of O_2 is produced from 68 g H_2O_2 at STP is produced from

$$\frac{68 \times 10}{22.7} \text{ g} = 29.9 \text{ g} \approx 30 \text{ g } \text{H}_2\text{O}_2$$

Therefore, strength of H_2O_2 in 10 volume H_2O_2 solution = 30 g/L = 3% H_2O_2 solution

6. Answer (3)



7. Answer (4)

Temporary Hardness of water is due to the presence of soluble salts of Mg and Ca in the form of bicarbonates in water.

8. Answer (4)

Hydrated sodium aluminium silicate is zeolite, written as $\text{NaAlSi}_3\text{O}_8$.

9. Answer (3)

In synthetic resins method, pure de-mineralised (de-ionized) water free from all soluble mineral salts is obtained by passing water successively through a cation exchange (in the H^+ form) and an anion exchange (in the OH^- form) resins.

10. Answer (1)

In synthetic resin method, the exhausted cation and anion exchange resin beds are regenerated by treatment with dilute acid and alkali solution respectively.

The s-Block Elements

10

Chapter

Marking Scheme

- For every correct answer you earn four marks (+4).
- For every incorrect answer you lose one mark (-1).

Marks Obtained	=	296
Maximum Marks		

Percentage Score

SECTION-I : NCERT Liners

Choose whether the statement is True (T) or False (F).

- Be shows diagonal relationship with Al.
- The hydration enthalpies of alkali metal ions increase with increase in ionic sizes.
- Potassium is lighter than sodium.
- Cs shows blue colour to an oxidizing flame.
- The superoxide O_2^- ion is stable only in presence of large cations such as K, Rb, Cs.
- Li react with dihydrogen at about 673 K to form hydride.
- Reaction of Li with water is more vigorous than that of Na.
- The solutions of alkali metals in liquid ammonia is paramagnetic in nature.
- Liquid sodium metal is used as a coolant in fast breeder nuclear reactors.
- The $\Delta_f H^\circ$ values for alkali metal fluorides become more negative on moving down the group.
- The order of melting and boiling points of alkali metal halides is $F^- < Cl^- < Br^- < I^-$.
- LiCl is soluble in ethanol, acetone and pyridine.
- Lithium carbonate is stable to heat.
- In Castner-Kellner cell mercury is used as cathode and carbon acts as anode.
- Sodium nitrate when heated gives sodium oxide.
- All alkali metal halides have positive enthalpy of formation.
- $CaCl_2$ is more soluble in water than NaCl.

T	F

18. Sodium hydrogencarbonate is known as baking soda. ☐
19. By saturating a solution of sodium carbonate with carbon dioxide, sodium bicarbonate is obtained. ☐
20. In human body sodium ions are the most abundant cations within cell fluids. ☐
21. Calcium imparts brick red colour to the flame. ☐
22. Among 2nd group metals, density of calcium is minimum. ☐
23. Mg burns with dazzling brilliance in air to give MgO and Mg₃N₂. ☐
24. Thermal decomposition of (NH₄)₂BeF₄ is the best route for the preparation of BeF₂. ☐
25. Milk of Magnesia is used as antacid in medicine. ☐
26. BeO is basic in nature. ☐
27. Beryllium chloride has a chain structure in vapour phase. ☐
28. Hydrated halides of Be and Mg on heating suffer Hydrolysis. ☐
29. Solubility order : MgCO₃ < CaCO₃ < SrCO₃ < BaCO₃ ☐
30. Beryllium carbonate is unstable and can be kept only in the atmosphere of CO₂. ☐
31. Magnesium nitrate crystallises with six molecules of water, whereas barium nitrate crystallises as the anhydrous salt. ☐
32. All nitrates of 2nd group metal decompose on heating to give the oxide, NO₂ and O₂. ☐
33. A suspension of slaked lime in water is known as milk of lime. ☐
34. Ca(OH)₂ reacts with chlorine to form chlorite, a constituent of bleaching powder. ☐
35. Dihydrate of calcium sulphate is known as plaster of paris. ☐
36. Important ingredients present in Portland cement are Dicalcium silicate (11%), Tricalcium silicate (26%) and Tricalcium aluminium (51%). ☐
37. All enzymes that utilize ATP in phosphate transfer require calcium as the cofactor. ☐
38. The calcium concentration in plasma of a human body is regulated at about 100 mg L⁻¹. ☐
39. Cement is obtained by mixing cement clinker with 2-3% by weight of gypsum. ☐

SECTION-II : Assertion-Reason type

In the following questions, a statement of assertion (A) is followed by a statement of reason (R).

- (1) If both Assertion & Reason are true and the Reason is the correct explanation of the Assertion, then mark (1).
- (2) If both Assertion & Reason are true but the Reason is not the correct explanation of the Assertion, then mark (2).
- (3) If Assertion is true statement but Reason is false, then mark (3).
- (4) If both Assertion & Reason are false statements, then mark (4).

1. A : Monovalent sodium and divalent calcium ions are found in large proportions in biological fluids. These ions perform important biological functions such as maintenance of ion balance and nerve impulse conduction.
R : The ionization enthalpies of the alkali metals are considerably high and increase down the group from Li to Cs.
2. A : The melting and boiling points of the alkali metals are low.
R : Alkali metals have weak metallic bonding.
3. A : The alkali metals are highly reactive.
R : Alkali metals have large size and low ionization enthalpy.
4. A : The alkali metals dissolve in liquid ammonia giving deep blue solutions.
R : The ammoniated electron absorbs energy in the visible region of light and imparts blue colour to the solution.
5. A : Slaked lime is used in white wash.
R : Slaked lime is disinfectant in nature.
6. A : Group IA metals are collectively known as the alkali metals.
R : Metals of group IA form hydroxides on reaction with water which are strongly alkaline in nature.
7. A : The elements of group IIA including beryllium are known as the alkaline earth metals.
R : Lithium and beryllium, the first elements of group 1 and group 2 respectively shows diagonal relationship with each other.
8. A : Alkali metals are normally kept in kerosene oil.
R : Lithium shows exceptional behaviour in reacting directly with nitrogen of air to form the nitride, Li_3N .
9. A : The main pigment for the absorption of light in plants is chlorophyll.
R : Chlorophyll contains magnesium.
10. A : KO_2 is a paramagnetic in nature.
R : O_2^- is paramagnetic due to presence of one unpaired electron in π^*2p molecular orbital.
11. A : Beryllium and magnesium are kinetically inert to oxygen and water.
R : All the alkaline earth metals combine with halogen at elevated temperature forming their halides.
12. A : Beryllium and magnesium do not impart any colour to the flame.
R : The electrons in beryllium and magnesium are too strongly bound to get excited by flame.
13. A : Compounds of alkaline earth metals are more extensively hydrated than those of alkali metals.
R : The hydration enthalpies of alkaline earth metal ions are larger than those of alkali metal ions due to their smaller size.
14. A : Caesium can be used in photoelectric cells.
R : Caesium has low ionisation energy.
15. A : Li is strongest reducing agent among all alkali metals.
R : Li^+ has high hydration energy.
16. A : AlF_6^{3-} can be formed but not BeF_6^{4-} .
R : Due to absence of vacant d -orbitals Be cannot exceed its covalency more than 4.
17. A : Ba(OH)_2 is more soluble in water than Be(OH)_2 .
R : The $\Delta H_{\text{solution}}$ is more negative for Ba than Be.
18. A : Sodium-lead alloy is used in the preparation of tetraethyl lead.
R : Tetraethyl lead is used as antiknocking agent in petrol.
19. A : Be and Mg do not form ionic hydrides.
R : Hydrides of Be and Mg are polymeric in structure.

20. A : LiF is insoluble in water.
R : LiF has high lattice energy.
21. A : The tendency to form ionic bonds among group 2 elements increases down the group.
R : The ionisation energy of alkaline earth metals decreases on moving down the group.
22. A : Compounds of alkaline earth metals are more extensively hydrated than those of alkali metals.
R : The charge density of alkaline earth metal ions is larger than those of alkali metal ions.
23. A : Among halides of alkali metals, lithium iodide is the most covalent in nature.
R : Li^+ ion is very small and I^- is large in size.
24. A : Lithium exhibits anomalous behaviour among alkali metals.
R : Lithium is having small size of its atoms and ion with high polarising power (*i.e.*, charge/radius ratio).
25. A : BeCl_2 fumes in moist air.
R : BeCl_2 reacts with moisture to form HCl gas.
26. A : MgCO_3 is soluble in water when a current of CO_2 is passed.
R : The solubility of MgCO_3 is due to the formation of $\text{Mg}(\text{HCO}_3)_2$.

SECTION-III : Check Your Understanding

PROBLEM 1:

Sodium carbonate is generally prepared by Solvay process. In this process, advantage is taken of the low solubility of sodium hydrogen carbonate where by it gets precipitated in the reaction of sodium chloride with ammonium hydrogen carbonate. Sodium carbonate is a white crystalline solid which exist as decahydrate, also called washing soda. It is used in the manufacture of glass, soap, borax and caustic soda.

On the basis of above paragraph, choose the correct option for the following questions.

- Solvay process cannot be extended to the manufacture of potassium carbonate because
 - KHCO_3 is highly soluble in water
 - K_2CO_3 is highly soluble in water
 - K_2CO_3 is thermally unstable compound
 - KHCO_3 is thermally unstable compound
- Which of the following compounds is not formed during the Solvay process?

(1) NH_4Cl	(2) NaHCO_3
(3) $(\text{NH}_4)_2\text{CO}_3$	(4) NaOH
- On heating above 373 K, washing soda changes to
 - $\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$
 - $\text{Na}_2\text{CO}_3 \cdot 5\text{H}_2\text{O}$
 - $\text{Na}_2\text{CO}_3 \cdot 8\text{H}_2\text{O}$
 - Na_2CO_3

PROBLEM 2:

The anomalous behaviour of lithium is due to the (i) exceptionally small size of its atom and ion, and (ii) high polarising power. As a result, there is increased covalent character of lithium compounds which is responsible for their solubility in organic solvents. Further, lithium shows diagonal relationship to magnesium.

On the basis of above paragraph, choose the correct option for the following questions.

- Lithium on combustion in air forms mainly
 - Li_2O and Li_2CO_3
 - Li_2O and Li_3N
 - Li_2CO_3 and Li_3N
 - Li_2O_2 and Li_2O
- Solid hydrogenbicarbonates are not formed by
 - Li and Ca
 - Na and Mg
 - Li and Mg
 - K and Ca
- LiCl and MgCl_2 crystallise from aqueous solution as
 - $\text{LiCl} \cdot \text{H}_2\text{O}$ and $\text{MgCl}_2 \cdot 8\text{H}_2\text{O}$
 - $\text{LiCl} \cdot \text{H}_2\text{O}$ and $\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$
 - $\text{LiCl} \cdot 2\text{H}_2\text{O}$ and $\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$
 - $\text{LiCl} \cdot 2\text{H}_2\text{O}$ and $\text{MgCl}_2 \cdot 8\text{H}_2\text{O}$

PROBLEM 3:

The solubility of ionic salts mainly depends on their lattice energy and the hydration energy of ions. On moving down the group, as size of metal ion increases, hydration energy and lattice energy both decreases. If decrease in lattice energy is more rapidly than the hydration energy, solubility of salts increases.

On the basis of above paragraph, choose the correct option for the following questions.

7. The correct order of solubility of sulphates of 2nd group elements is
- (1) $\text{SrSO}_4 > \text{CaSO}_4 > \text{MgSO}_4 > \text{BeSO}_4$
 - (2) $\text{BeSO}_4 > \text{MgSO}_4 > \text{SrSO}_4 > \text{CaSO}_4$
 - (3) $\text{BeSO}_4 > \text{MgSO}_4 > \text{CaSO}_4 > \text{SrSO}_4$
 - (4) $\text{BeSO}_4 > \text{SrSO}_4 > \text{CaSO}_4 > \text{MgSO}_4$

8. Select the incorrect statement among the following.

- (1) Low solubility of LiF in water is due to its high lattice enthalpy
- (2) Low solubility of CsF in water is due to its smaller hydration enthalpy
- (3) NaOH dissolve freely in water
- (4) CaCO_3 is soluble in water

9. The most soluble hydroxide among the following is

- (1) Ba(OH)_2
- (2) Mg(OH)_2
- (3) Sr(OH)_2
- (4) Ca(OH)_2



Chapter-10 : The s-Block Elements

SECTION-I : NCERT Liners

- | | | |
|------------------------------|------------------------------|------------------------------|
| 1. (T), [NCERT-XI, Pg. 310] | 14. (T), [NCERT-XI, Pg. 305] | 27. (F), [NCERT-XI, Pg. 309] |
| 2. (F), [NCERT-XI, Pg. 300] | 15. (F), [NCERT-XI, Pg. 304] | 28. (T), [NCERT-XI, Pg. 309] |
| 3. (T), [NCERT-XI, Pg. 300] | 16. (F), [NCERT-XI, Pg. 303] | 29. (F), [NCERT-XI, Pg. 309] |
| 4. (T), [NCERT-XI, Pg. 300] | 17. (T), [NCERT-XI, Pg. 305] | 30. (T), [NCERT-XI, Pg. 309] |
| 5. (T), [NCERT-XI, Pg. 301] | 18. (T), [NCERT-XI, Pg. 306] | 31. (T), [NCERT-XI, Pg. 309] |
| 6. (F), [NCERT-XI, Pg. 302] | 19. (T), [NCERT-XI, Pg. 306] | 32. (T), [NCERT-XI, Pg. 309] |
| 7. (F), [NCERT-XI, Pg. 302] | 20. (F), [NCERT-XI, Pg. 306] | 33. (T), [NCERT-XI, Pg. 311] |
| 8. (T), [NCERT-XI, Pg. 302] | 21. (T), [NCERT-XI, Pg. 308] | 34. (T), [NCERT-XI, Pg. 311] |
| 9. (T), [NCERT-XI, Pg. 302] | 22. (T), [NCERT-XI, Pg. 307] | 35. (F), [NCERT-XI, Pg. 311] |
| 10. (F), [NCERT-XI, Pg. 303] | 23. (T), [NCERT-XI, Pg. 308] | 36. (F), [NCERT-XI, Pg. 312] |
| 11. (F), [NCERT-XI, Pg. 303] | 24. (T), [NCERT-XI, Pg. 308] | 37. (F), [NCERT-XI, Pg. 312] |
| 12. (T), [NCERT-XI, Pg. 303] | 25. (T), [NCERT-XI, Pg. 308] | 38. (T), [NCERT-XI, Pg. 312] |
| 13. (F), [NCERT-XI, Pg. 303] | 26. (F), [NCERT-XI, Pg. 309] | 39. (T), [NCERT-XI, Pg. 312] |

SECTION-II : Assertion-Reason type

- | | | |
|--------|---------|---------|
| 1. (3) | 10. (1) | 19. (2) |
| 2. (1) | 11. (2) | 20. (1) |
| 3. (2) | 12. (1) | 21. (1) |
| 4. (1) | 13. (1) | 22. (1) |
| 5. (1) | 14. (1) | 23. (1) |
| 6. (1) | 15. (1) | 24. (1) |
| 7. (4) | 16. (1) | 25. (1) |
| 8. (2) | 17. (1) | 26. (1) |
| 9. (2) | 18. (2) | |

SECTION-III : Check Your Understanding

- Answer (1)
Solvay process cannot be extended to the manufacture of potassium carbonate because potassium hydrogen carbonate is too soluble to be precipitated by the addition of ammonium hydrogen carbonate to a saturated solution of KCl.
- Answer (4)
Solvay's process:

$$2\text{NH}_3 + \text{H}_2\text{O} + \text{CO}_2 \rightarrow (\text{NH}_4)_2\text{CO}_3$$

$$(\text{NH}_4)_2\text{CO}_3 + \text{H}_2\text{O} + \text{CO}_2 \rightarrow 2\text{NH}_4\text{HCO}_3$$
- $$\text{NH}_4\text{HCO}_3 + \text{NaCl} \rightarrow \text{NH}_4\text{Cl} + \text{NaHCO}_3$$

$$2\text{NaHCO}_3 \rightarrow \text{Na}_2\text{CO}_3 + \text{CO}_2 + \text{H}_2\text{O}$$
- Answer (4)

$$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O} \xrightarrow{T > 373 \text{ K}} \text{Na}_2\text{CO}_3 + 10\text{H}_2\text{O}$$
- Answer (2)
Li on combustion in air forms mainly Li_2O and Li_3N .
- Answer (3)
Solid Hydrogencarbonates are not formed by Li and Mg.

- | | |
|--|---|
| <p>6. Answer (4)
Both LiCl and MgCl_2 are deliquescent and crystallise from aqueous solution as hydrates, $\text{LiCl} \cdot 2\text{H}_2\text{O}$ and $\text{MgCl}_2 \cdot 8\text{H}_2\text{O}$.</p> <p>7. Answer (3)
The solubility of sulphates of 2nd group elements decreases on moving down the group.</p> | <p>8. Answer (4)
Carbonates of alkaline earth metals are insoluble in water.</p> <p>9. Answer (1)
The solubility increases with increasing atomic number from $\text{Mg}(\text{OH})_2$ to $\text{Ba}(\text{OH})_2$.</p> |
|--|---|

Marking Scheme

- For every correct answer you earn four marks (+4).
- For every incorrect answer you lose one mark (-1).

Marks Obtained	=	Percentage Score
Maximum Marks	384	

SECTION-I : NCERT Liners

Choose whether the statement is True (T) or False (F).

- The maximum oxidation state shown by a p-block element is equal to the total number of valence electrons.
- Kernite is $\text{Na}_2\text{B}_4\text{O}_7 \cdot 4\text{H}_2\text{O}$.
- Atomic number of radioactive element Nihonium is 113.
- Atomic radius of Ga is less than that of Al.
- Order of first ionization enthalpy : $\text{B} > \text{Ga} > \text{Al} > \text{In} > \text{Tl}$
- Order of electronegativity : $\text{B} > \text{Ga} > \text{In} > \text{Tl} > \text{Al}$
- Gallium has unusually low melting point (303 K).
- Stability of +1 oxidation state : $\text{Al} < \text{Ga} < \text{In} < \text{Tl}$
- Indium oxide is amphoteric in nature.
- Concentrated nitric acid renders Al passive by forming a passive oxide layer on the surface.
- White fumes appear around the bottle of anhydrous aluminium chloride.
- AlCl_3 is dimerised through Halogen bridging.
- Maximum covalence of Boron is 6.
- Borax dissolves in water to give an acidic solution.
- Borax give brown coloured bead with CoO in borax bead test.
- Orthoboric acid can be prepared by acidifying an aqueous solution of borax.
- Boric acid is weak monobasic Lewis acid.

T	F
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18. Orthoboric acid on heating above 370 K forms HBO_2 .
19. Diborane is produced on an industrial scale by the reaction of NaBH_4 with I_2 .
20. Diborane is colourless, non-toxic gas.
21. Boranes are readily hydrolysed by water to give boric acid.
22. Diborane undergoes cleavage reaction with CO to give borane adduct.
23. $\text{B}_3\text{N}_3\text{H}_6$ is known as inorganic benzene.
24. Boron fibres are used in making bullet-proof vest.
25. Boron-10 (^{10}B) isotope has high ability of absorb neutrons.
26. An aqueous solution of orthoboric acid is generally used as a mild antiseptic.
27. Flerovium ($Z = 114$) is a naturally occurring radioactive element.
28. Correct order of first ionization enthalpy : $\text{C} > \text{Si} > \text{Ge} > \text{Sn} > \text{Pb}$
29. Silicon and germanium are metalloids.
30. Lead compound in +2 state are stable due to inert pair effects.
31. Hybridisation of Si in SiF_6^{2-} is sp^3d^2 .
32. GeO_2 is amphoteric in nature.
33. Tin decomposes steam to form monoxide and dihydrogen gas.
34. All tetra fluorides of 14th groups are covalent compound.
35. PbI_4 has doubtful existence
36. Order of Catenation : $\text{C} \gg \text{Si} > \text{Ge} \approx \text{Sn}$
37. Diamond is the hardest natural substance on the Earth.
38. Fullerenes are the only pure form of carbon.
39. $\Delta_f H^\circ$: Diamond $>$ Fullerene (C_{60}) $>$ Graphite
40. Pure CO can be prepared by dehydration of formic acid with conc. H_2SO_4 at 373 K.
41. Mixture of CO and N_2 is known as producer gas.
42. CO-haemoglobin complex is more stable than oxygen-haemoglobin complex.

43. $\text{H}_2\text{CO}_3 / \text{HCO}_3^-$ buffer system helps to maintain the pH of human blood. ☐
44. CO_2 is used as fire extinguisher. ☐
45. CO_2 molecule has two resonating structures. ☐
46. Quartz, cristobalite and tridymite are amorphous form of silica. ☐
47. Silicon dioxide is a giant molecule in which eight membered rings are formed. ☐
48. Quartz is extensively used as a piezoelectric material. ☐
49. Kieselguhr is a crystalline form of silica. ☐
50. CH_3Cl on reaction with Si in presence of copper as catalyst at 573 K forms mixture of MeSiCl_3 , Me_2SiCl_2 , Me_3SiCl and Me_4Si . ☐
51. Feldspar is naturally occurring silicate. ☐
52. The basic structural unit of silicate is SiO_4^{4-} . ☐
53. Hydrated zeolites are used as ion exchangers in softening of 'hard' water. ☐
54. CO is a neutral oxide. ☐
55. ZSM-5 is used to convert Alkanes directly into gasoline. ☐
56. Glass and cement are man-made Silicates. ☐
57. Correct order of atomic radius: $\text{B} < \text{Al} < \text{Ga} < \text{In} < \text{Tl}$ ☐

SECTION-II : Assertion-Reason type

In the following questions, a statement of assertion (A) is followed by a statement of reason (R).

- (1) If both Assertion & Reason are true and the Reason is the correct explanation of the Assertion, then mark (1).
- (2) If both Assertion & Reason are true but the Reason is not the correct explanation of the Assertion, then mark (2).
- (3) If Assertion is true statement but Reason is false, then mark (3).
- (4) If both Assertion & Reason are false statements, then mark (4).

1. A: There is discontinuity observed in the ionization enthalpy values between Al and Ga, similarly between In and Tl.
R: Screening effect of *d* and *f* electrons is poor.
2. A: Boron has unusually high melting point.
R: Boron has very strong crystalline lattice.
3. A: Boron forms only covalent compounds.
R: The sum of first three ionization enthalpies of boron is very high due to small size of boron. This prevents it to form +3 ion.
4. A: Boron is unable to form BF_6^{3-} ion.
R: Boron is unable to expand its octet due to non-availability of *d* orbitals.
5. A: Boric acid is polymeric.
R: There is presence of hydrogen bonds in boric acid.

6. A : Increased content of CO_2 in atmosphere is considered as a cause of increase in "Greenhouse effect".
R : Carbon monoxide is highly poisonous to human body due to higher stability of its haemoglobin complex as compared to that of oxyhaemoglobin complex.
7. A : Ti^{3+} is more stable in solution than Ti^+ .
R : Aluminium dissolves in dilute HCl and liberates chlorine gas.
8. A : Aluminium shows amphoteric character whereas boron does not.
R : Aluminium dissolves in mineral acids and aqueous alkalis whereas boron does not react with acids and alkalis even at moderate temperature.
9. A : The atomic radius of gallium (135 pm) is less than that of aluminium (143 pm).
R : The heavier elements do form π bonds but this involves d orbitals ($d\pi - p\pi$ or $d\pi - d\pi$).
10. A : Boric acid is considered as a weak acid.
R : Boric acid is not able to release H^+ ions on its own. It receives OH^- ions from water molecule to complete its octet and in turn releases H^+ ions.
11. A : Graphite conducts electricity.
R : Electrons are mobile and delocalised over the whole sheet of graphite.
12. A : Orthoboric acid is a weak monobasic acid.
R : Basicity of orthoboric acid is one.
13. A : Acidic strength of halides of boron follow the order : $\text{BI}_3 > \text{BBr}_3 > \text{BCl}_3 > \text{BF}_3$
R : Boron is the element of group 13.
14. A : Thallium can show +1 oxidation state.
R : Thallium exhibits inert pair effect.
15. A : Al is a metal.
R : Al_2O_3 is amphoteric oxide.
16. A : At room temperature, SiO_2 is a solid while CO_2 is a gas.
R : CO_2 is monomeric, having linear structure while SiO_2 is a 3-D network solid.
17. A : Silica in its normal form is almost non-reactive.
R : Si – O bond in silica has very high bond enthalpy.
18. A : Hybridisation of B in BF_4^- is sp^3 .
R : Boron trifluoride is a Lewis acid.
19. A : Pb^{4+} has more oxidising power than that of Pb^{2+} .
R : Due to inert pair effect Pb^{2+} is more stable.
20. A : $[\text{SiCl}_6]^{2-}$ is not known.
R : Six large chloride ions cannot be accommodated around Si^{4+} due to limitation of its size.
21. A : Silicones are hydrophobic in nature.
R : Simple silicones consists of $\left(\begin{array}{c} | \\ -\text{Si}-\text{O}- \\ | \end{array} \right)_n$ chain.
22. A : Carbon is able to show allotropic forms.
R : Carbon is having property of catenation and $p\pi-p\pi$ bond formation.
23. A : CCl_4 doesn't undergo hydrolysis while SiCl_4 does.
R : There is the presence of vacant d orbital in silicon while carbon doesn't have d orbital.
24. A : The correct molecular formula of borax is $\text{Na}_2[\text{B}_4\text{O}_5(\text{OH})_4] \cdot 8\text{H}_2\text{O}$.
R : Borax contains the tetranuclear unit $[\text{B}_4\text{O}_5(\text{OH})_4]^{2-}$.
25. A : CO molecule acts as a electron pair donor and reacts with certain metals when heated to form metal carbonyls.
R : In CO molecule, there are one sigma and two pi bonds between carbon and oxygen.
26. A : Carbon dioxide can be obtained as a solid in the form of dry ice.
R : Dry ice is used as a refrigerant for ice-cream and frozen food.

27. A : BF_3 behave as Lewis acid.

R : The availability of 3 valence electrons ($2s^2 2p^1$) in Boron for covalent bond formation using four orbitals ($2s, 2p_x, 2p_y$ and $2p_z$) leads to electron deficient BF_3 .

28. A : B-F bond lengths in BF_3 are shorter than the sum of the covalent radii.

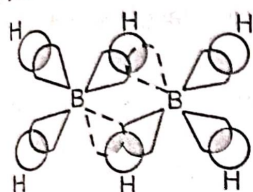
R : $p\pi - p\pi$ interaction exists and all B - F bonds are equivalent.

29. A : AlCl_3 forms dimer Al_2Cl_6 but it dissolves in H_2O forming $[\text{Al}(\text{H}_2\text{O})_6]^{3+}$ and Cl^- ions.

R : Aqueous solution of AlCl_3 is acidic due to hydrolysis.

SECTION-III : Check Your Understanding

PROBLEM 1:

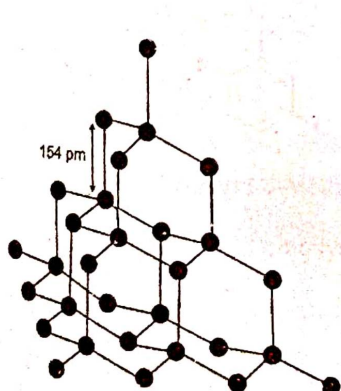


: Bonding in Diborane

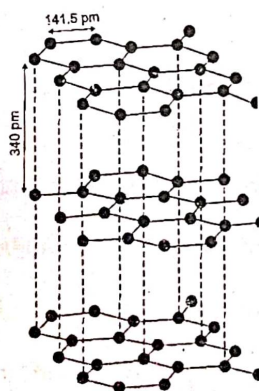
On the basis of above diagram, choose the correct option for the following questions

- Hybridisation of boron in diborane is
 - sp^2
 - sp^3
 - sp
 - sp^3d
- Diborane contains
 - Two 2c-2e bonds
 - Two 3c-2e bonds
 - Four 3c-2e bonds
 - Six 2c-2e bonds
- The maximum number of atoms in a plane of B_2H_6 molecule is
 - 8
 - 4
 - 3
 - 6

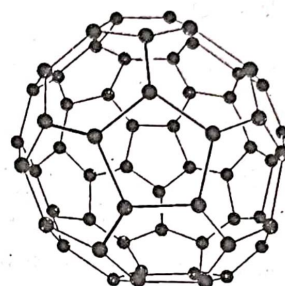
PROBLEM 2:



The structure of diamond



The structure of graphite

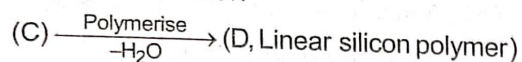
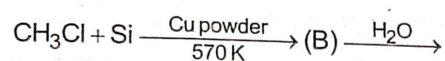


The structure of C_{60} , Buckminster fullerene

On the basis of above structures, choose the correct option for the following questions

- Hybridisation of carbons in Diamond, graphite and Buckminster-fullerene respectively are
 - sp^3, sp^2 and sp^2
 - sp^3, sp^2 and sp^3
 - sp^2, sp^2 and sp^3
 - sp^3, sp^3 and sp^2
- Buckminster fullerene (C_{60}) contains
 - 20 six-membered rings and 14 five membered rings
 - 12 six-membered rings and 14 five membered rings
 - 12 six-membered rings and 20 five membered rings
 - 20 six-membered rings and 12 five membered rings
- Incorrect statement among the following is
 - Graphite has layered structure and layers are held by van der Waals forces.
 - Graphite cleaves easily between the layers so used as a dry lubricant.
 - Density of Diamond is more than that of graphite.
 - Diamond is covalent so it has low melting point.

PROBLEM 3:



On the basis of above sequence of reactions, choose the correct option for the following questions

7. The repeating unit in D is

- (1) $\text{-(CH}_3\text{)}_3\text{SiO-}$
- (2) $\text{-(CH}_3\text{)}_2\text{SiO-}$
- (3) $\text{-(CH}_3\text{SiO}_2\text{)-}$
- (4) $\text{-(CH}_3\text{SiO)-}$

8. The chain length of the polymer (D) can be controlled by adding

- (1) $(\text{CH}_3)_4\text{Si}$
- (2) $(\text{CH}_3)_2\text{SiCl}_2$
- (3) CH_3SiCl_3
- (4) $(\text{CH}_3)_3\text{SiCl}$

9. Compound (C) is

- (1) $\text{CH}_3\text{Si(OH)}_3$
- (2) $(\text{CH}_3)_3\text{SiOH}$
- (3) $(\text{CH}_3)_2\text{Si(OH)}_2$
- (4) $(\text{CH}_3)_2\text{SiO}$

10. Correct statement regarding D is/are

- (1) It is water repelling in nature
- (2) It has high dielectric strength and thermal stability
- (3) It is used as grease
- (4) All of these



crystallise from aqueous solution as hydrates, $\text{LiCl} \cdot 2\text{H}_2\text{O}$ and $\text{MgCl}_2 \cdot 8\text{H}_2\text{O}$.

7. Answer (3)

The solubility of sulphates of 2nd group elements decreases on moving down the group.

9. Answer (1)

The solubility increases with increasing atomic number from $\text{Mg}(\text{OH})_2$ to $\text{Ba}(\text{OH})_2$.

Chapter-11 : The p-Block Elements

SECTION-I : NCERT Liners

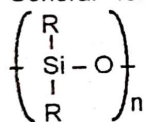
- | | | |
|------------------------------|------------------------------|------------------------------|
| 1. (T), [NCERT-XI, Pg. 315] | 20. (F), [NCERT-XI, Pg. 321] | 39. (F), [NCERT-XI, Pg. 327] |
| 2. (T), [NCERT-XI, Pg. 317] | 21. (T), [NCERT-XI, Pg. 321] | 40. (T), [NCERT-XI, Pg. 327] |
| 3. (T), [NCERT-XI, Pg. 317] | 22. (T), [NCERT-XI, Pg. 321] | 41. (T), [NCERT-XI, Pg. 327] |
| 4. (T), [NCERT-XI, Pg. 317] | 23. (T), [NCERT-XI, Pg. 321] | 42. (F), [NCERT-XI, Pg. 328] |
| 5. (F), [NCERT-XI, Pg. 318] | 24. (T), [NCERT-XI, Pg. 322] | 43. (T), [NCERT-XI, Pg. 328] |
| 6. (F), [NCERT-XI, Pg. 318] | 25. (T), [NCERT-XI, Pg. 322] | 44. (T), [NCERT-XI, Pg. 328] |
| 7. (T), [NCERT-XI, Pg. 318] | 26. (T), [NCERT-XI, Pg. 322] | 45. (F), [NCERT-XI, Pg. 328] |
| 8. (T), [NCERT-XI, Pg. 318] | 27. (F), [NCERT-XI, Pg. 323] | 46. (F), [NCERT-XI, Pg. 328] |
| 9. (F), [NCERT-XI, Pg. 319] | 28. (F), [NCERT-XI, Pg. 323] | 47. (T), [NCERT-XI, Pg. 329] |
| 10. (T), [NCERT-XI, Pg. 319] | 29. (F), [NCERT-XI, Pg. 324] | 48. (T), [NCERT-XI, Pg. 329] |
| 11. (T), [NCERT-XI, Pg. 320] | 30. (T), [NCERT-XI, Pg. 324] | 49. (F), [NCERT-XI, Pg. 329] |
| 12. (T), [NCERT-XI, Pg. 320] | 31. (T), [NCERT-XI, Pg. 324] | 50. (T), [NCERT-XI, Pg. 329] |
| 13. (F), [NCERT-XI, Pg. 320] | 32. (F), [NCERT-XI, Pg. 324] | 51. (T), [NCERT-XI, Pg. 330] |
| 14. (F), [NCERT-XI, Pg. 320] | 33. (F), [NCERT-XI, Pg. 324] | 52. (T), [NCERT-XI, Pg. 330] |
| 15. (F), [NCERT-XI, Pg. 320] | 34. (F), [NCERT-XI, Pg. 324] | 53. (T), [NCERT-XI, Pg. 330] |
| 16. (T), [NCERT-XI, Pg. 320] | 35. (T), [NCERT-XI, Pg. 324] | 54. (T), [NCERT-XI, Pg. 331] |
| 17. (T), [NCERT-XI, Pg. 321] | 36. (T), [NCERT-XI, Pg. 325] | 55. (F), [NCERT-XI, Pg. 330] |
| 18. (T), [NCERT-XI, Pg. 321] | 37. (T), [NCERT-XI, Pg. 326] | 56. (T), [NCERT-XI, Pg. 330] |
| 19. (F), [NCERT-XI, Pg. 321] | 38. (T), [NCERT-XI, Pg. 327] | 57. (F), [NCERT-XI, Pg. 318] |

SECTION-II : Assertion-Reason type

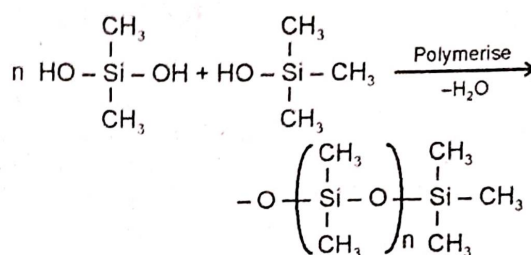
- | | | |
|---------|---------|---------|
| 1. (1) | 11. (1) | 21. (2) |
| 2. (1) | 12. (2) | 22. (1) |
| 3. (1) | 13. (2) | 23. (1) |
| 4. (1) | 14. (1) | 24. (1) |
| 5. (1) | 15. (2) | 25. (2) |
| 6. (2) | 16. (1) | 26. (2) |
| 7. (4) | 17. (1) | 27. (1) |
| 8. (1) | 18. (2) | 28. (1) |
| 9. (2) | 19. (1) | 29. (2) |
| 10. (1) | 20. (1) | |

SECTION-III : Check Your Understanding

1. Answer (2)
Boron atoms in B_2H_6 are sp^3 hybridised.
2. Answer (2)
Diborane contains four 2c-2e bonds and two 3c-2e bonds.
3. Answer (4)
Maximum number of atoms in a plane of B_2H_6 molecule is 6 (two boron atoms with four hydrogen atoms).
4. Answer (1)
Diamond: sp^3 , graphite: sp^2 , Buckminster-Fullerence : sp^2 .
5. Answer (4)
Buckminster-Fullerence (C_{60}) contains 20 six-membered rings and 12 five membered rings.
6. Answer (4)
Diamond has a three-dimensional network involving strong c-c- bonds, which are very difficult to break and, in turn has high melting point.
7. Answer (2)
General formula for linear silicon polymer:



8. Answer (4)
The chain length of the polymer can be controlled by adding $(CH_3)_3SiCl$ which blocks the ends as shown



9. Answer (3)

$$2CH_3Cl + Si \xrightarrow[570\text{ K}]{\text{Cu powder}} (CH_3)_2SiCl_2 \xrightarrow[-2HCl]{+ 2H_2O}$$

(B)

$$(CH_3)_2Si(OH)_2 \xrightarrow[-H_2O]{\text{Polymerise}} -O - \left(\begin{array}{c} CH_3 \\ | \\ Si - O \\ | \\ CH_3 \end{array} \right)_n - \begin{array}{c} CH_3 \\ | \\ Si - CH_3 \\ | \\ CH_3 \end{array}$$

(C) Silicone (D)
10. Answer (4)
Silicones (D), being surrounded by non-polar alkyl groups are water repelling in nature. They have in general high thermal stability and high dielectric strength. They are used as sealant, greases and for water proofing of fabrics.

Organic Chemistry - Some Basic Principles and Techniques

12

Chapter

Marking Scheme

- For every correct answer you earn four marks (+4).
- For every incorrect answer you lose one mark (-1).

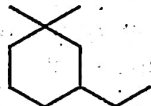
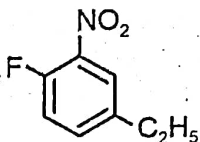
Marks Obtained

Maximum Marks = 196

Percentage Score

SECTION-I : NCERT Liners

Choose whether the statement is True (T) or False (F).

- The change in hybridisation affects the electronegativity of carbon atom.
- In ethene, p orbitals on adjacent carbon atoms have parallel orientation.
- Number of σ -bonds present in a urea molecule is 6.
- Tetrahydrofuran is a homocyclic compound.
- Tropone is non-benzenoid aromatic compound.
- Thiophene is nitrogen containing heterocyclic aromatic compound.
- The structural unit, $(\text{CH}_3)_3\text{CCH}_2-$ is a neopentyl group.
- The order of decreasing priority of the functional groups: $-\text{COCl} > -\text{CN} > -\text{CONH}_2 > -\text{HC}=\text{O}$.
- IUPAC group prefix for $-\text{CHO}$ is called carbamoyl.
- IUPAC name of  is 1-Ethyl-3, 3-dimethylcyclohexane.
- IUPAC name of  is 4-Ethyl-1-fluoro-2-nitrobenzene.
- 2-Methylpentane and 3-Methylpentane are chain isomers.
- Methoxypropane and ethoxyethane are metamers to each other.
- Tert-butyl cation is more stable than isopropyl cation.
- Methyl carbocation is pyramidal in shape.
- Carbon of methyl anion is sp^3 hybridised.

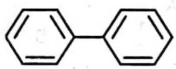
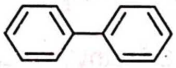
T	F
☐	☐
☐	☐
☐	☐
☐	☐
☐	☐
☐	☐
☐	☐
☐	☐
☐	☐
☐	☐
☐	☐
☐	☐
☐	☐
☐	☐
☐	☐

17. Homolytic cleavage leads to the formation of free radicals.
18. A reagent that brings an electron pair to the reactive site is called electrophile.
19. Canonical structures are hypothetical and individually do not represent any real molecule / ion.
20. Benzene is a hybrid of two resonance structures.
21. $-\text{NHCOR}$, show $-\text{R}$ effect when attached with benzene ring.
22. Fractional distillation is used to separate different fractions of crude oil in petroleum industry.
23. Column chromatography is a type of partition chromatography.
24. AgCl and AgI are soluble in NH_4OH .
25. Ammonium phosphomolybdate is a yellow colour compound.
26. Sulphur is estimated by Dumas method.
27. $[\text{Fe}(\text{SCN})]^{2+}$ is a blood red colour species.

SECTION-II : Assertion-Reason type

In the following questions, a statement of assertion (A) is followed by a statement of reason (R).

- (1) If both Assertion & Reason are true and the Reason is the correct explanation of the Assertion, then mark (1).
- (2) If both Assertion & Reason are true but the Reason is not the correct explanation of the Assertion, then mark (2).
- (3) If Assertion is true statement but Reason is false, then mark (3).
- (4) If both Assertion & Reason are false statements, then mark (4).

1. A: $(\text{CH}_3)_2\overset{+}{\text{C}}\text{H}$ is more stable than $\text{CH}_3\overset{+}{\text{C}}\text{H}_2$ and $\overset{+}{\text{C}}\text{H}_3$ cation.
R: Hyperconjugation interaction in $\text{CH}_3\overset{+}{\text{C}}\text{H}_2$ is greater than in $(\text{CH}_3)_2\overset{+}{\text{C}}\text{H}$.
2. A: 1-propanol and 2-propanol are position isomers.
R: Position isomers have same molecular formula but different position of substituents.
3. A: 1,3-Butadiene is a planar molecule.
R: Each carbon of 1,3-butadiene is sp^2 hybridised.
4. A: Ethylene glycol cannot be purified by steam distillation.
R: Ethylene glycol is miscible with water due to presence of hydrogen bonding.
5. A: Nitro group when attached to benzene ring reduces the electron density in the benzene ring.
R: $-\text{NO}_2$ has strong $-\text{I}$ and $-\text{R}$ effect.
6. A:  has 12π electrons.
R:  is an aromatic compound.
7. A: The allyl free radical is more stable than ethyl free radical.
R: The allyl free radical is stabilised by resonance.
8. A: A free radical is formed in homolytic fission of covalent bond.
R: A free radical is paramagnetic species.

9. A : Inductive effect is a permanent effect.
R : Inductive effect weakens steadily with increasing distance from the substituent.
10. A : Benzene is more stable than the hypothetical cyclohexatriene.
R : The presence of delocalised π -electrons in benzene makes it more stable.
11. A : Nitrogen, sulphur, halogen and phosphorus present in an organic compound are detected by Lassaigne's test.
R : In the above test the elements present in the compound are converted from covalent form into the ionic form by fusing the compound with sodium metal.

SECTION-III : Check Your Understanding

PROBLEM 1:

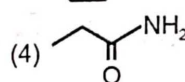
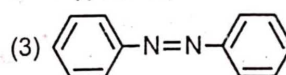
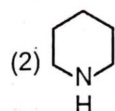
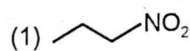
Purification, qualitative and quantitative analysis of organic compounds are carried out for determining their structures. The methods of purification namely: sublimation, distillation and differential extraction are based on the difference in one or more physical properties. Chromatography is a useful technique of separation, identification and purification of compounds. It is classified into two categories: adsorption and partition chromatography. After getting the compound in a pure form, its qualitative analysis is carried out for detection of elements present in it. Nitrogen, sulphur, halogens (Cl, Br, I) and phosphorus are detected by Lassaigne's test. Carbon and hydrogen are estimated by determining the amounts of CO_2 and H_2O produced. Nitrogen is estimated by Dumas or Kjeldahl's method and halogens by Carius method. Sulphur and phosphorus are estimated by oxidising them to sulphuric and phosphoric acids respectively.

On the basis of above passage, answer the following questions.

- Mixture of chloroform and aniline is purified by
 - Distillation
 - Fractional distillation
 - Differential extraction
 - Distillation under reduced pressure
- Consider the following statements about chromatography
 - Silica gel can be used as an adsorbent in column chromatography
 - Thin layer chromatography is a type of adsorption chromatography
 - In paper chromatography, the chromatography paper contains water trapped in it, which acts as stationary phase

The correct statement are

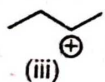
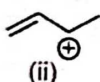
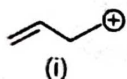
- (a) and (b) only
 - (b) and (c) only
 - (a) and (c) only
 - (a), (b) and (c)
3. In the Lassaigne's test for nitrogen in an organic compound, the Prussian blue colour is obtained due to the formation of
- $\text{Na}_4[\text{Fe}(\text{CN})_6]$
 - $\text{Fe}_2[\text{Fe}(\text{CN})_6]$
 - $\text{Fe}_3[\text{Fe}(\text{CN})_6]$
 - $\text{Fe}_4[\text{Fe}(\text{CN})_6]_3$
4. Colour of $[\text{Fe}(\text{CN})_5\text{NOS}]^{4-}$ is
- Blood red
 - Violet
 - Green
 - Yellow
5. In Carius method of estimation of halogen, 0.8 g of an organic compound gave 0.94 g of AgBr . The percentage of bromine present in the organic compound is (Atomic mass of $\text{Ag} = 108 \text{ u}$ and $\text{Br} = 80 \text{ u}$)
- 34%
 - 62%
 - 25%
 - 50%
6. Which among the following compounds will not be estimated by Kjeldahl's method?



PROBLEM 2:

Organic reaction mechanism concepts are based on the structure of the substrate molecule, fission of a covalent bond, the attacking reagents, the electron displacement effects and the conditions of the reaction. These organic reactions involve breaking and making of covalent bonds. A covalent bond may be cleaved in **heterolytic** or homolytic fashion. A heterolytic cleavage yields **carbocations** or **carbanions**, while a homolytic cleavage gives **free radicals** as reactive intermediate. Reactions proceeding through heterolytic cleavage involve the complimentary pairs of reactive species. These are electron pair donor known as **nucleophile** and an electron pair acceptor known as **electrophile**. The **inductive**, **resonance**, **electromeric** and **hyperconjugation** effects may help in the polarisation of a bond making certain carbon atom or other atom positions as places of low or high electron densities.

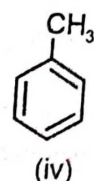
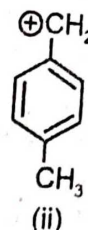
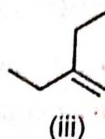
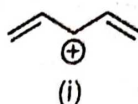
7. Consider the following carbocations



the **correct** order of stability is

- (1) (ii) > (i) > (iii)
- (2) (i) > (ii) > (iii)
- (3) (ii) > (iii) > (i)
- (4) (iii) > (ii) > (i)

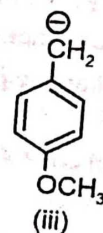
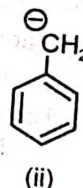
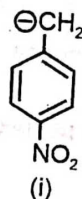
8. Hyperconjugation effect is not observed in



- (1) (i) and (iii) only
 - (2) (i), (ii) and (iii) only
 - (3) (i) only
 - (4) (i), (ii) and (iv) only
9. Consider the following statements
- (a) Electromeric effect is a permanent effect
 - (b) Inductive effect operates through σ -bond
 - (c) Aniline has five resonating structures
 - (d) -CN when attached with benzene shows -I and +R effect

The **correct** statements are

- (1) (b) and (c) only
 - (2) (a), (b) and (c) only
 - (3) (c) and (d) only
 - (4) (a), (b), (c) and (d)
10. Correct order of stability of the given carbanions is



- (1) (iii) > (i) > (ii)
 - (2) (iii) > (ii) > (i)
 - (3) (i) > (ii) > (iii)
 - (4) (i) > (iii) > (ii)
11. Nucleophile among the following is
- (1) BF_3
 - (2) AlCl_3
 - (3) SO_3
 - (4) H_2O

Chapter-12 : Organic Chemistry - Some Basic Principles and Techniques

SECTION-I : NCERT Liners

- | | | |
|-----------------------------|------------------------------|------------------------------|
| 1. (T), [NCERT-XI, Pg. 335] | 10. (F), [NCERT-XI, Pg. 343] | 19. (T), [NCERT-XI, Pg. 353] |
| 2. (T), [NCERT-XI, Pg. 335] | 11. (T), [NCERT-XI, Pg. 348] | 20. (T), [NCERT-XI, Pg. 353] |
| 3. (F), [NCERT-XI, Pg. 335] | 12. (T), [NCERT-XI, Pg. 348] | 21. (F), [NCERT-XI, Pg. 358] |
| 4. (F), [NCERT-XI, Pg. 339] | 13. (T), [NCERT-XI, Pg. 349] | 22. (T), [NCERT-XI, Pg. 358] |
| 5. (T), [NCERT-XI, Pg. 339] | 14. (T), [NCERT-XI, Pg. 349] | 23. (F), [NCERT-XI, Pg. 360] |
| 6. (F), [NCERT-XI, Pg. 340] | 15. (F), [NCERT-XI, Pg. 350] | 24. (F), [NCERT-XI, Pg. 363] |
| 7. (T), [NCERT-XI, Pg. 341] | 16. (T), [NCERT-XI, Pg. 350] | 25. (T), [NCERT-XI, Pg. 363] |
| 8. (F), [NCERT-XI, Pg. 344] | 17. (T), [NCERT-XI, Pg. 350] | 26. (F), [NCERT-XI, Pg. 364] |
| 9. (F), [NCERT-XI, Pg. 345] | 18. (F), [NCERT-XI, Pg. 351] | 27. (T), [NCERT-XI, Pg. 363] |

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SECTION-II : Assertion-Reason type

- | | | |
|--------|--------|---------|
| 1. (3) | 5. (1) | 9. (2) |
| 2. (1) | 6. (2) | 10. (1) |
| 3. (1) | 7. (1) | 11. (2) |
| 4. (1) | 8. (2) | |

SECTION-III : Check Your Understanding

- Answer (1)
The liquids having sufficient difference in their boiling points are purified by distillation. Boiling points CHCl_3 and aniline are 334 K and 457 K respectively.
- Answer (4)
Silica gel and alumina are commonly used adsorbent in column chromatography.
- Answer (4)

$$6\text{CN}^- + \text{Fe}^{2+} \rightarrow [\text{Fe}(\text{CN})_6]^{4-}$$

$$3[\text{Fe}(\text{CN})_6]^{4-} + 4\text{Fe}^{3+} \rightarrow \text{Fe}_4[\text{Fe}(\text{CN})_6]_3$$

Prussian blue
- Answer (2)

$$\text{S}^{2-} + [\text{Fe}(\text{CN})_5\text{NO}]^{2-} \rightarrow [\text{Fe}(\text{CN})_5\text{NOS}]^{4-}$$

Violet
- Answer (4)
 188 g of AgBr contains 80 g bromine
 0.94 g of AgBr contains $\frac{80}{188} \times 0.94$ g bromine

$$\text{Percentage of bromine} = \frac{80 \times 0.94 \times 100}{188 \times 0.8}$$

$$= 50\%$$
- Answer (4)
Kjeldahl method is not applicable to compound containing nitrogen in nitro, azo groups and nitrogen present in the ring as nitrogen of these

compounds does not change to ammonium sulphate under Kjeldahl experimental conditions.

- Answer (3)
 2° allylic carbocation will be most stable because of resonance and hyperconjugation effects.
 2° carbocation is more stable than 1° carbocation where π bond is not in conjugation.
- Answer (3)
Hyperconjugation involves delocalisation of σ electrons of C-H bond of an allyl group directly attached to an atom of unsaturated system or to an atom with an unshared p-orbital.
- Answer (1)
 - Electromeric effect is a temporary effect.
 - $-\text{CN}$ when attached with benzene shows -I and -R effect.
- Answer (3)
Electron withdrawing group present at para position stabilises the carbanion by -R effect while electron donating group destabilises it by +R effect.
- Answer (4)
 BF_3 , AlCl_3 , SO_3 can accept electrons hence these are electrophiles while lone pair of oxygen in H_2O can be donated to electron deficient species hence it is a nucleophile.

Marking Scheme

- For every correct answer you earn four marks (+4).
- For every incorrect answer you lose one mark (-1).

Marks Obtained

Maximum Marks

188

Percentage Score

SECTION-I : NCERT Liners

Choose whether the statement is True (T) or False (F).

- | | T | F |
|--|--------------------------|--------------------------|
| 1. C_7H_{16} has nine structural isomers. | ☐ | ☐ |
| 2. Ethyl chloride on reaction with zinc and dilute HCl gives ethene. | ☐ | ☐ |
| 3. Solvent used in Wurtz reaction is dry ether. | ☐ | ☐ |
| 4. Sodium acetate on heating with soda lime gives ethane as major product. | ☐ | ☐ |
| 5. Electrolysis of aqueous solution of sodium butanoate gives H_2 gas at anode. | ☐ | ☐ |
| 6. Melting point of 2, 2-dimethylpropane is more than 2-methylbutane. | ☐ | ☐ |
| 7. For a given alkane, the rate of reaction of alkanes with halogens in presence of light is $F_2 > Cl_2 > Br_2 > I_2$ | ☐ | ☐ |
| 8. One mole of butane requires four moles of O_2 for complete combustion. | ☐ | ☐ |
| 9. Methane on reaction with oxygen in presence of copper catalyst at 523 K and 100 atm pressure gives methanal as major product. | ☐ | ☐ |
| 10. 2-methylpropane on reaction with $KMnO_4$ gives 2-methylpropan-2-ol. | ☐ | ☐ |
| 11. n-Alkanes on heating in presence of anhydrous $AlCl_3$ and HCl gas isomerise to branched chain alkanes. | ☐ | ☐ |
| 12. n-hexane on reaction with V_2O_5 at 773 K and 10-20 atm pressure gives cyclohexane as major product. | ☐ | ☐ |
| 13. Ethane has infinite number of conformational isomers. | ☐ | ☐ |
| 14. Conformations of ethane other than eclipsed and staggered are called skew conformations. | ☐ | ☐ |
| 15. Boiling point of trans-but-2-ene is greater than cis-but-2-ene. | ☐ | ☐ |
| 16. But-2-yne on reaction with Na in presence of liquid ammonia gives trans-but-2-ene as major product. | ☐ | ☐ |

17. Dehydrohalogenation reaction to prepare alkene is also known as β -elimination reaction ☐
18. The reactivity order of addition of hydrogen halides to an alkene follows the order : $\text{HCl} > \text{HBr} > \text{HI}$. ☐
19. Addition of HBr to propene in presence of dibenzoyl peroxide gives 2-bromopropane as major product. ☐
20. Ethane does not decolorise the reddish-brown colour of bromine taken in CCl_4 solution. ☐
21. Calcium carbide on hydrolysis gives ethene gas. ☐
22. Polyacetylene, under special conditions, conducts electricity. ☐
23. The absence of pure double bond in benzene accounts for the reluctance of benzene to show addition reactions under normal conditions. ☐
24. Phenanthrene is aromatic in nature and contains 10π electrons. ☐
25. In arenium ion, one carbon atom is sp^3 hybridised. ☐

SECTION-II : Assertion-Reason type

In the following questions, a statement of assertion (A) is followed by a statement of reason (R).

- (1) If both Assertion & Reason are true and the Reason is the correct explanation of the Assertion, then mark (1).
- (2) If both Assertion & Reason are true but the Reason is not the correct explanation of the Assertion, then mark (2).
- (3) If Assertion is true statement but Reason is false, then mark (3).
- (4) If both Assertion & Reason are false statements, then mark (4).

1. A : Methane can not be prepared by Kolbe's electrolytic method.
R : An aqueous solution of sodium or potassium salt of carboxylic acid on electrolysis gives alkane containing even number of carbon atom.
2. A : Eclipsed and staggered are two conformations of ethane.
R : In all the conformations, the bond angles and bond lengths remain same.
3. A : Of all the conformations of ethane, the staggered form has the lower torsional strain than the eclipsed form.
R : Magnitude of torsional strain depends upon the angle of rotation about C – C bond.
4. A : Soda lime is a decarboxylating agent.
R : Soda lime is a mixture of sodium hydroxide and calcium oxide.
5. A : Propene on reaction with HBr gives 2-Bromopropane as major product.
R : Addition of HBr with alkene take place according to Markovnikov's rule.
6. A : 2-butyne on controlled hydrogenation in presence of Lindlar's catalyst gives cis-2-butene.
R : Partial reduction of alkyne using Lindlar catalyst is 'syn' hydrogenation.
7. A : Vicinal dihalides on heating with zinc dust form an alkene.
R : Dihalides in which two halogen atoms are attached to two adjacent carbon atoms are known as vicinal dihalides.
8. A : Alkane are non-polar molecules.
R : The C – C and C – H bond in alkane are covalent in nature.

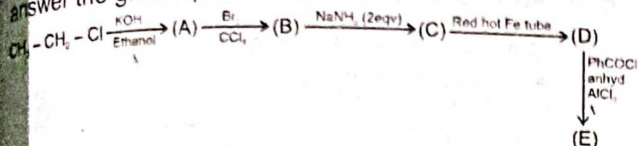
9. A: Boiling point of n-pentane is higher than neopentane.
R: Surface area of n-pentane is higher than neopentane.

10. A: Friedel Crafts acylation of benzene is done using acetic anhydride in presence of anhydrous AlCl_3 .
R: Friedel Crafts acylation is an example of electrophilic substitution reaction.

SECTION-III : Check Your Understanding

PROBLEM 1:

Consider the following reaction sequence and answer the given questions.



- Consider the following statements about (A)
 - (A) on reaction with Baeyer's reagent gives ethylene glycol
 - It is the monomer of polythene
 - (A) on reaction with cold concentrated sulphuric acid forms ethyl hydrogen sulphate
 - It shows geometrical isomerism

The correct statements are

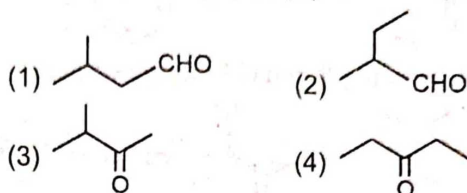
 - (1) (a) and (b) only
 - (2) (a), (b), (c) and (d)
 - (3) (a), (b) and (c) only
 - (4) (a) and (c) only
- Incorrect statement about (C) is
 - (1) It is more acidic than ethene
 - (2) It liberate H_2 gas on reaction with sodium
 - (3) A gem dibromide is formed on reaction of (C) with excess of HBr
 - (4) It does not decolourise bromine- CCl_4 solution
- Number of σ and π bonds present in compound (E) respectively are
 - (1) 22 and 6
 - (2) 23 and 6
 - (3) 25 and 7
 - (4) 14 and 4

PROBLEM 2:

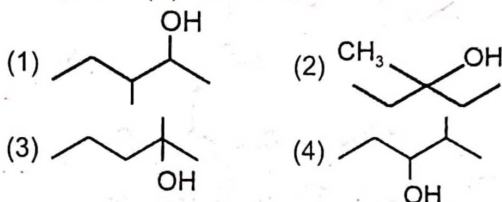
Read the given passage and answer the following questions.

An organic compound (A) having molecular formula $\text{C}_4\text{H}_{12}\text{Br}_2$ on reaction with Zinc dust gives compound (B). Compound (B) on reductive ozonolysis gives compound (C) and (D). Compound (D) can also be obtained by heating methane and oxygen in presence of Mo_2O_3 . Compound (B) on heating with acidified KMnO_4 solution gives 2-methylbutanoic acid while (B) on reaction with dilute H_2SO_4 gives compound (E) as major product.

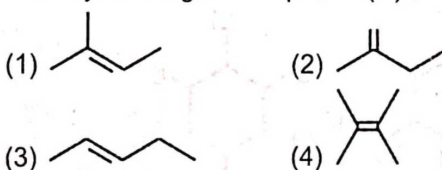
4. Structure of compound (C) is



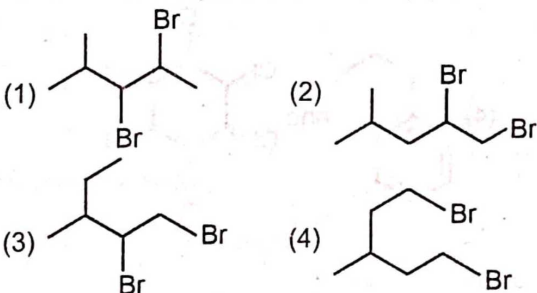
5. Compound (E) will be



6. Which of the following compounds on reductive ozonolysis will give compound (D)

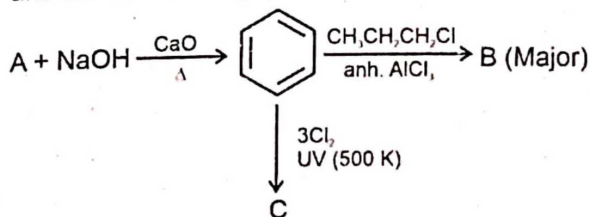


7. Structure of compound dibromide (A) is

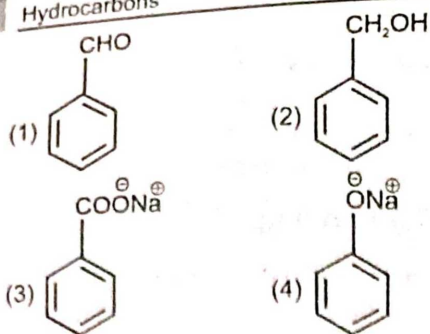


PROBLEM 3:

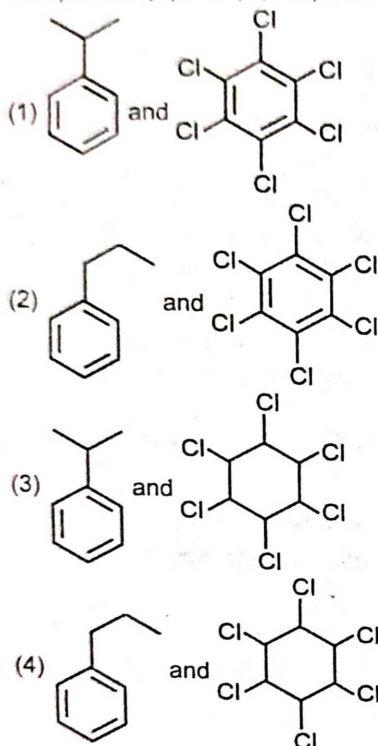
Consider the following reaction sequence and answer the following questions



8. Compound (A) will be



9. Compounds (B) and (C) respectively are

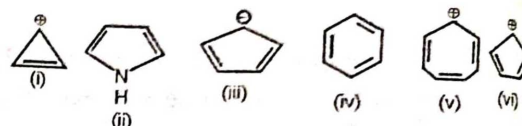


PROBLEM 4:

Read the passage and answer the given questions.

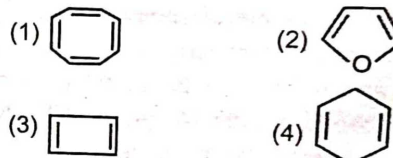
Benzene and benzenoid compounds show aromatic character, Aromaticity, the property of being aromatic is possessed by compounds having specific electronic structure characterized by Huckel $(4n + 2) \pi$ electron rule. The nature of groups or substituents attached to benzene ring is responsible for activation or deactivation of the benzene ring towards further electronic substitution and also for orientation of the incoming group.

10. Out of the given species, how many are aromatic in nature?



- (1) 5 (2) 6
(3) 4 (4) 3

11. Antiaromatic species among the following is



12. The pair of species which are both meta directing in nature towards electrophilic substitution reaction is

- (1) $-\text{COR}$ and $-\text{NHCOCH}_3$
(2) $-\text{COOH}$ and $-\text{OCH}_3$
(3) $-\text{SO}_3\text{H}$ and $-\text{CHO}$
(4) $-\text{CN}$ and $-\text{NHR}$

Chapter-13 : Hydrocarbons

SECTION-I : NCERT Liners

- | | | |
|-----------------------------|------------------------------|------------------------------|
| 1. (T), [NCERT-XI, Pg. 376] | 6. (T), [NCERT-XI, Pg. 380] | 11. (T), [NCERT-XI, Pg. 382] |
| 2. (F), [NCERT-XI, Pg. 379] | 7. (T), [NCERT-XI, Pg. 381] | 12. (F), [NCERT-XI, Pg. 382] |
| 3. (T), [NCERT-XI, Pg. 379] | 8. (F), [NCERT-XI, Pg. 381] | 13. (T), [NCERT-XI, Pg. 383] |
| 4. (F), [NCERT-XI, Pg. 379] | 9. (F), [NCERT-XI, Pg. 382] | 14. (T), [NCERT-XI, Pg. 383] |
| 5. (F), [NCERT-XI, Pg. 379] | 10. (T), [NCERT-XI, Pg. 382] | 15. (F), [NCERT-XI, Pg. 386] |

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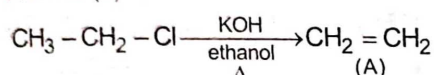
16. (T), [NCERT-XI, Pg. 387] 20. (T), [NCERT-XI, Pg. 389] 24. (F), [NCERT-XI, Pg. 399]
 17. (T), [NCERT-XI, Pg. 388] 21. (F), [NCERT-XI, Pg. 394] 25. (T), [NCERT-XI, Pg. 401]
 18. (F), [NCERT-XI, Pg. 389] 22. (T) [NCERT-XI, Pg. 395]
 19. (F), [NCERT-XI, Pg. 390] 23. (T), [NCERT-XI, Pg. 399]

SECTION-II : Assertion-Reason type

1. (1) 5. (1) 9. (1)
 2. (2) 6. (1) 10. (2)
 3. (2) 7. (2)
 4. (2) 8. (2)

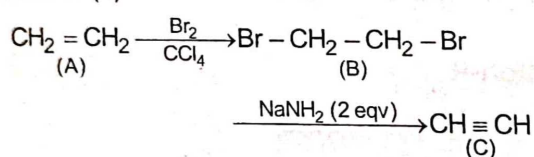
SECTION-III : Check Your Understanding

1. Answer (3)

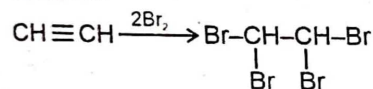


Ethene does not show geometrical isomerism.

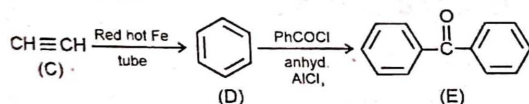
2. Answer (4)



Acetylene decolourises reddish brown colour of bromine.



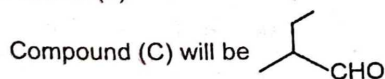
3. Answer (3)



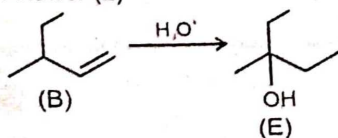
Number of σ bonds in (E) = 25

Number of π bonds in (E) = 7

4. Answer (2)

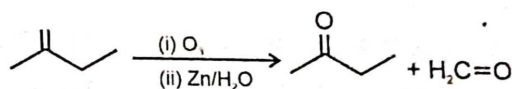


5. Answer (2)

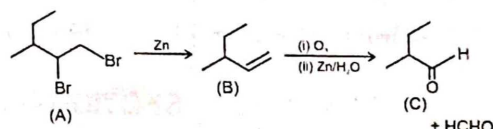


6. Answer (2)

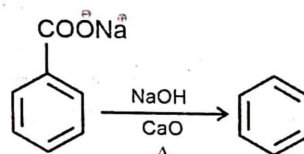
Compound (D) is HCHO



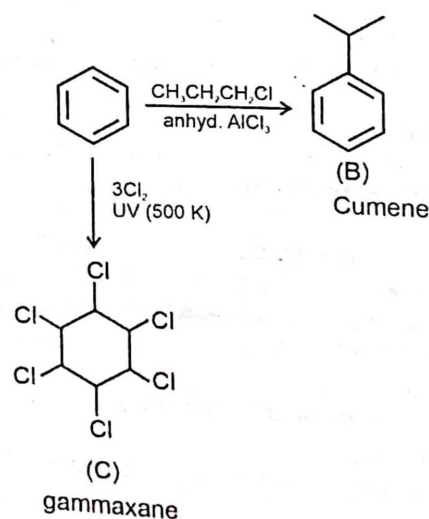
7. Answer (3)



8. Answer (3)



9. Answer (3)



10. Answer (1)

Cyclic, planar species having $(4n + 2)\pi$ electrons in conjugation will be aromatic in nature.

11. Answer (3)

Cyclic, $4n\pi$ electronic species which is less stable than its acyclic analogue is antiaromatic

in nature. Cyclobutadiene is diradical type species and antiaromatic in nature.

12. Answer (3)

- $-\text{SO}_3\text{H}$, $-\text{CHO}$, $-\text{COR}$, $-\text{CN}$ and $-\text{COOH}$ are meta directing in nature
- $-\text{NHCOCH}_3$, $-\text{OCH}_3$, $-\text{NHR}$ are o/p directing in nature.

Marking Scheme

1. For every correct answer you earn four marks (+4).
 2. For every incorrect answer you lose one mark (-1).

Marks Obtained	=	Percentage Score
Maximum Marks	172	

SECTION-I : NCERT Liners

Choose whether the statement is True (T) or False (F).

- | | T | F |
|--|--------------------------|--------------------------|
| 1. The photochemical smog contains ozone, nitric oxide, formaldehyde, acrolein and PAN. | ☐ | ☐ |
| 2. Clean water would have a BOD value of less than 5 ppm. | ☐ | ☐ |
| 3. Bhopal gas tragedy was caused by CH_3CN . | ☐ | ☐ |
| 4. Acid rain is due to reaction of SO_2 , NO_2 and CO_2 with rain water. | ☐ | ☐ |
| 5. The greenhouse gas is N_2 . | ☐ | ☐ |
| 6. Carboxyhaemoglobin is more stable than oxygen-haemoglobin complex. | ☐ | ☐ |
| 7. Green chemistry is a production process that would bring about minimum pollution or deterioration to the environment. | ☐ | ☐ |
| 8. PAN is a powerful eye irritant. | ☐ | ☐ |
| 9. Ozone in the stratosphere is depleted by CF_2Cl_2 . | ☐ | ☐ |
| 10. Classical smog is essentially caused by the presence of oxides of sulphur. | ☐ | ☐ |
| 11. Plastic and nuclear waste pollutants is difficult to remove from the environment. | ☐ | ☐ |
| 12. The process in which nutrient enriched water bodies support a dense plant population which kills animal life by depriving it of oxygen is called Eutrophication. | ☐ | ☐ |
| 13. The upper limit of Mn in drinking water is 0.5 ppm. | ☐ | ☐ |
| 14. Nitrogen dioxide is brown in colour. | ☐ | ☐ |
| 15. The Taj Mahal in India has been affected by acid rain. | ☐ | ☐ |
| 16. Nitrogen dioxide is a lung irritant that can lead to an acute respiratory disease in children. | ☐ | ☐ |
| 17. Normally rain water has a pH of 6.6. | ☐ | ☐ |

18. If we control the primary precursors only such as NO_2 and hydrocarbon the photochemical smog will automatically be reduced. ☐
19. DDT is use in agriculture to control the damages caused by insects rodents weeds and various crop diseases. ☐
20. Most herbicides are not toxic to mammals. ☐

SECTION-II : Assertion-Reason type

In the following questions, a statement of assertion (A) is followed by a statement of reason (R).

- (1) If both Assertion & Reason are true and the Reason is the correct explanation of the Assertion, then mark (1).
(2) If both Assertion & Reason are true but the Reason is not the correct explanation of the Assertion, then mark (2).
(3) If Assertion is true statement but Reason is false, then mark (3).
(4) If both Assertion & Reason are false statements, then mark (4).

1. A : Normally rain water has a pH of 5.6.
R : Rain water reacts with carbon dioxide which is present in the atmosphere, forming H^+ (aq.) ion.
2. A : Ozone (O_3) protects us from the harmful ultraviolet (UV) radiation ($\lambda = 255 \text{ nm}$) coming from the sun.
R : Ozone is thermodynamically stable and decomposes to oxygen atom.
3. A : Water soluble inorganic chemicals that include heavy metals such as cadmium, mercury, nickel that are dangerous to humans.
R : Human body cannot excrete water soluble heavy metals. Over a period of time, these deposited metals may damage kidneys, CNS and liver etc.
4. A : The air around the city of Agra, where the Taj Mahal is located, contains fairly high level of sulphur and nitrogen oxides.
R : A large number of industries and power plants around the Taj Mahal area is situated.
5. A : Nitrogen dioxide is a lung irritant that can lead to an acute respiratory disease in children.
R : Rate of production of NO_2 is slower when nitric oxide reacts with ozone in the stratosphere.
6. A : The increased amount of CO in the air is mainly responsible for global warming.
R : Photochemical smog has high concentration of reducing agents and is, therefore, called as reducing smog.
7. A : The hazardous effect of ozone depletion is skin cancer.
R : Ozone hole is caused by chlorofluorocarbons.
8. A : BOD in clean water should be less than 5 ppm.
R : BOD is biochemical oxygen demand.
9. A : Ozone is present in stratosphere.
R : It is a product of infrared radiation acting on O_2 .
10. A : CO is a air pollutant.
R : CO is colourless and odourless.
11. A : Heavy metals such as cadmium, mercury are dangerous to humans.
R : Human body cannot excrete heavy metals such as cadmium, mercury.
12. A : The maximum limit of nitrate in drinking water is 50 ppm.
R : Excess nitrate above 50 ppm can cause blue baby syndrome.
13. A : The common components of photochemical smog are ozone, nitric oxide, acrolein, formaldehyde and PAN.
R : Both ozone and PAN act as powerful eye irritants.

SECTION-III : Check Your Understanding**PROBLEM 1:**

Green chemistry is a way of thinking and is about utilising the existing knowledge and principles of chemistry and other sciences to reduce the adverse impact on environment. Green chemistry is a production process that would bring about minimum pollution or deterioration to the environment. Such processes are not only environmental unfriendly but also cost-ineffective. Utilisation of existing knowledge base for reducing the chemical hazards along with the developmental activities is the foundation of green chemistry in a chemical reaction, if reactants are fully converted into useful environmental friendly products by using an environment friendly medium then, there would be no chemical pollutants introduced in the environment.

- Which of the following compound replaced chlorine gas for the bleaching of paper?
(1) H_2O_2 (2) SO_2
(3) CH_3OH (4) $\text{CCl}_2 = \text{CCl}_2$
- Which of the following is an environmental friendly solvent for dry cleaning?
(1) CO_2 (2) $\text{Cl}_2\text{C} = \text{CCl}_2$
(3) $\text{CH}_2 = \text{CH}_2$ (4) C_6H_{14}

PROBLEM 2:

In 1980s atmospheric scientists working in Antarctica reported about depletion of ozone layer commonly known as ozone hole over the South Pole. It was found that a unique set of conditions was responsible for the ozone hole. In summer season, nitrogen dioxide and methane react with chlorine monoxide and chlorine atoms forming chlorine sinks, preventing much ozone depletion, whereas in winter, special type of clouds called polar stratospheric clouds are formed over Antarctica. These polar stratospheric clouds provide surface on which chlorine nitrate formed gets hydrolysed to form hypochlorous acid. It also reacts with hydrogen chloride produced to give molecular chlorine.

- Earth is protected from UV rays by
(1) O_3 (2) CO_2
(3) SO_2 (4) Cl_2

- Ozone depletion in antartica is due to the formation of the following compound

- (1) ClONO_2
- (2) Cl_2NO_2
- (3) ClONO
- (4) ClON

PROBLEM 3:

Water pollution arises from human activities. Contamination reaches surface or groundwater through various routes such as municipal and industrial discharge pipes. Here pollutants enter the water body that cannot be easily detected, for example, agricultural runoff (from farms, animals and croplands), acid rain, storm-water runoff (from roads, parking lots and lawns). The most serious water pollutants are the disease causing agents called pathogens. Pathogens include bacteria and other organisms that enter water from domestic sewage and animal excreta. The other major water pollutant is organic matter such as leaves, grass, trash etc.

- For polluted water BOD is higher than
(1) 5
(2) 17
(3) 5.5
(4) 7
- The upper limit of Cd in drinking water is
(1) 0.05 ppm
(2) 0.005 ppm
(3) 0.5 ppm
(4) 5 ppm
- Measurement of dissolved oxygen that would be needed by the microorganism to oxidise the compounds is known as
(1) PAN
(2) DOB
(3) BOD
(4) COD

PROBLEM 4:

The word smog is derived from smoke and fog. This is the most common example of air pollution that occurs in many cities throughout the world. There are two types of smog. First one is Classical smog occurs in cool humid climate. Second one is Photochemical smog occurs in hot, dry and sunny climates. Photochemical smog causes serious health problems such as burning of eyes, chest pain, dryness of throat, cough and difficulty in breathing. Photochemical smog causes rubber to crack and extensive damage to plant life. It also causes corrosion of metals.

8. Select the correct statement regarding smog.
- A. Photochemical smog is formed through photochemical reaction involving solar energy.
 - B. Photochemical smog does not cause irritation in eyes and throat.

C. Photochemical smog causes corrosion of rubber and painted surface.

- (1) A and B only
 - (2) B and C only
 - (3) A and C only
 - (4) A, B and C
9. Photochemical smog includes the reduction of
- (1) NO^+
 - (2) NO_2
 - (3) NO_3^-
 - (4) O_2
10. The classical smog is a mixture of
- (1) Fog and nitrogen dioxide
 - (2) Fog and Sulphur dioxide
 - (3) Nitrogen dioxide and Sulphur dioxide
 - (4) Ozone and Fog

□ □ □

Chapter-14 : Environmental Chemistry

SECTION-I : NCERT Liners

- | | | |
|------------------------------|-------------------------------|-------------------------------|
| 1. (T), [NCERT- XI, Pg. 412] | 8. (T), [NCERT- XI, Pg. 412] | 15. (T), [NCERT- XI, Pg. 410] |
| 2. (T), [NCERT- XI, Pg. 415] | 9. (T), [NCERT- XI, Pg. 413] | 16. (T), [NCERT- XI, Pg. 407] |
| 3. (F), [NCERT- XI, Pg. 418] | 10. (T), [NCERT- XI, Pg. 411] | 17. (F), [NCERT- XI, Pg. 409] |
| 4. (T), [NCERT- XI, Pg. 409] | 11. (T), [NCERT- XI, Pg. 406] | 18. (F), [NCERT- XI, Pg. 413] |
| 5. (F), [NCERT- XI, Pg. 408] | 12. (T), [NCERT- XI, Pg. 415] | 19. (T), [NCERT- XI, Pg. 416] |
| 6. (T), [NCERT- XI, Pg. 408] | 13. (F), [NCERT- XI, Pg. 416] | 20. (F), [NCERT- XI, Pg. 417] |
| 7. (T), [NCERT- XI, Pg. 419] | 14. (T), [NCERT- XI, Pg. 412] | |

SECTION-II : Assertion-Reason type

- | | | |
|--------|---------|---------|
| 1. (1) | 6. (4) | 11. (1) |
| 2. (3) | 7. (2) | 12. (1) |
| 3. (1) | 8. (2) | 13. (2) |
| 4. (1) | 9. (3) | |
| 5. (3) | 10. (2) | |

SECTION-III : Check Your Understanding

- | | |
|--|--|
| 1. Answer (1)
H_2O_2 replaced Cl_2 gas for the bleaching of paper. | 7. Answer (3)
BOD |
| 2. Answer (1)
Environmental friendly solvent are liquid CO_2 and H_2O_2 for dry cleaning. | 8. Answer (3)
Statement A and C are correct.
NO_2 is absorbs energy from sunlight and breaks up into nitric oxide and free oxygen atom
photochemical smog is an oxidising agent in character. |
| 3. Answer (1)
Ozone layer protects us from UV rays. | 9. Answer (2)
Photochemical smog includes the reduction of NO_2 . |
| 4. Answer (1)
Ozone depletion in Antarctica is due to the formation of $ClONO_2$. | 10. Answer (2)
The classical smog is a mixture of fog and Sulphur dioxide. |
| 5. Answer (2)
The polluted water BOD is above 17. | |
| 6. Answer (2)
The upper limit of cd in drinking water is 0.005 ppm. | |